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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

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Vol. 2. No. 5 Pittsburgh, Pa. May, 1929

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RICHARD RIMBACH

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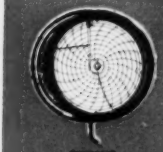

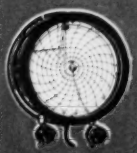

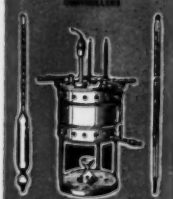

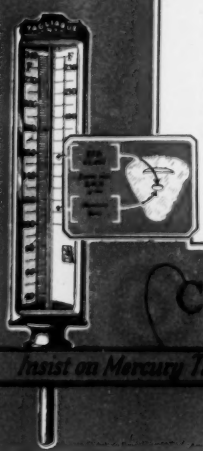

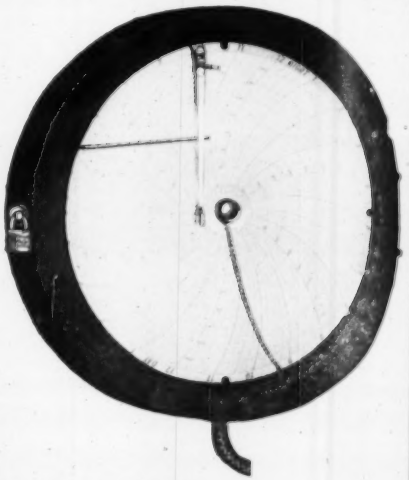

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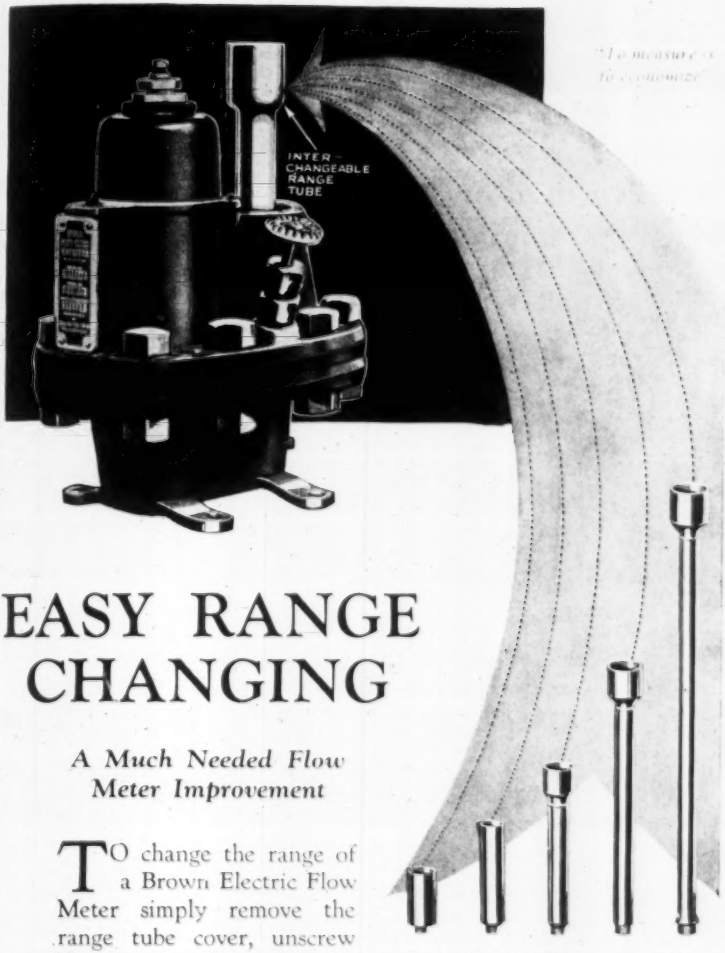

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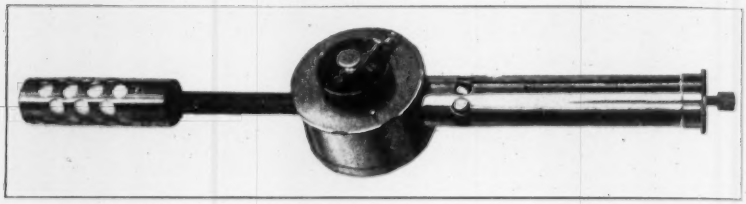

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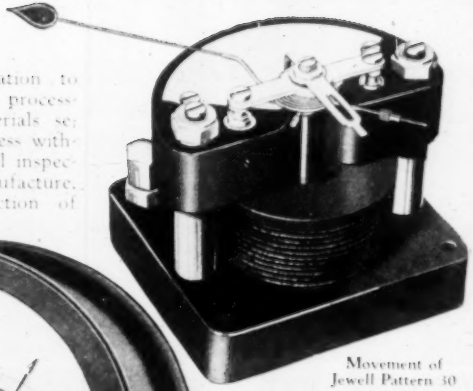

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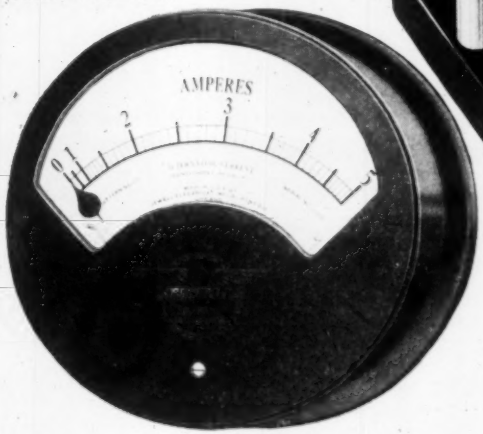

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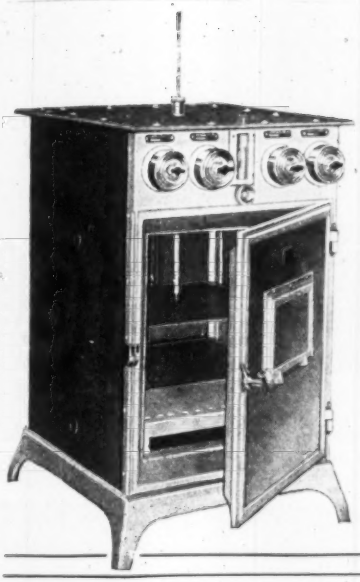
16. .....



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D.C. Voltage
SO_2
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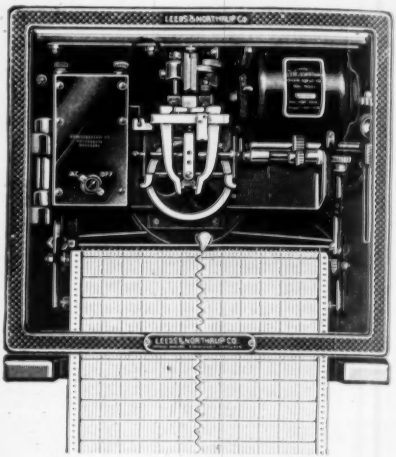
Power Totalizing
Water Level



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The mechanical unit is a series of rugged cams and levers, adjusted to the most modern standards of accuracy. This unit is driven by an electric motor, and all parts are standardized.

Recorders are made for any one of four types of chart, and about 160 chart ranges are on hand. We shall be glad to discuss applications to specific measuring problems.

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INDUSTRIAL — SCIENTIFIC

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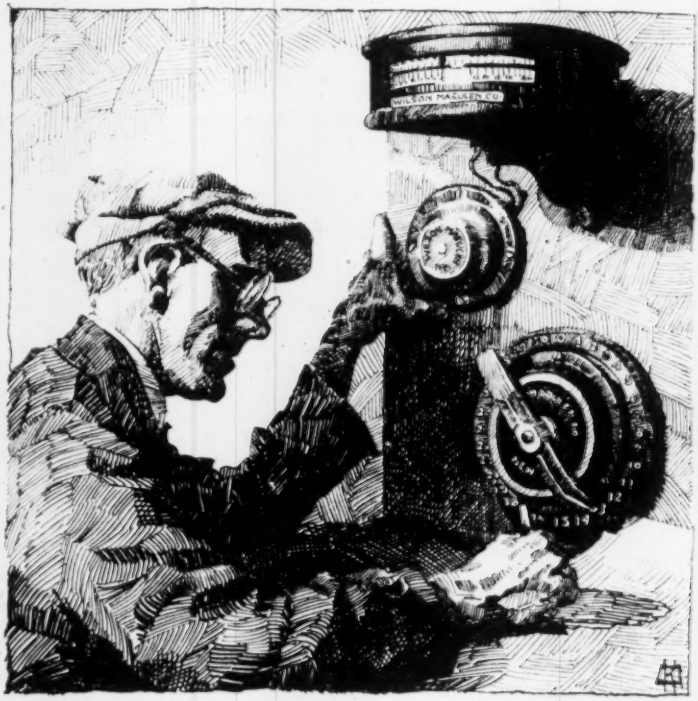
Have your stenographer cut out and mount the index found bound in the back of this issue, listing the principal articles. They will direct you to valuable information to which you may wish to refer in the future.



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Vol. 2, No. 5 MAY, 1929 Pittsburgh, Pa.

To Our Readers

THE representatives of two foreign manufacturers have seen fit to appeal to the users of instruments in advertisements in "SCIENCE", asking the users to protest the retention of the tariff of 1922. They advance arguments against sections of the tariff and appeal to all scientists to urge a return of duty free importation for educational, etc., institutions.

The editor presents the facts of the case in an article entitled "The Proposed Tariff and Instruments" in this issue and asks the readers to consider those facts and after thoroughly studying them, to draw their own conclusions.

The proper place to advance arguments for or against sections of the Tariff is before the open hearings of the Ways and Means Committee of the House. The members of that Committee have the benefit of all the facts collected by the Tariff Commission and are very well informed on this subect. Before framing the 1922 Tariff, days were devoted to hearings on this subject—at the recent hearings they again devoted considerable time to this matter. In these hearings, a large number of American makers and users have appeared but the foreign makers have never appeared at any open hearings.

——— :: ———

An American Instrument Industry Essential to National Defense

THE following is an extract from a statement of Major R. W. Pinger, representing the War Department of the United States in open hearing of Ways and Means Committee on February 23rd, 1929.

"The Assistant Secretary of War has designated me to appear and show the relation existing between the scientific instrument industry and national defense.

I have a typical scientific instrument, a panoramic gun sight—that is only one of some 200 items which the Ordnance Department is supposed to furnish the Army of the United States in time of War. The other departments, Medical, Chemical Warfare, Engineers, Air Corps and Signal Corps all have somewhat similar but smaller problems.

Anything in the tariff which tends to injure the scientific instrument industry which would make these things in time of war would be prejudicial to the national defense.

I would like to read a statement by Mr. Benedict Crowell, Assistant Secretary of war during the late war:

> "The optical industry in this country before the war was in the hands of few firms. Several of these were under German influence and one firm was directly affiliated with the Carl Zeiss Works of Jena, Germany; the workmen were largely German or of a German origin; the kinds and designs of apparatus produced were for the most part essentially European in character; optical glass was procured entirely from abroad and chiefly from Germany.
>
> There has been developed in this country a manufacturing capacity for precision, optical and instrument work, which, if desired, will render us independent of foreign markets.
>
> At the present time American manufacturers are in a position to make instruments of precision equal to the best European product, and the industry will continue, provided there is an adequate market for its product. Such a market will exist if universities and commercial laboratories of the country will obtain scientific apparatus from American manufacturers rather than import it from abroad as was heretofore the custom."

Three years later the 1922 Tariff eliminated duty-free importation, thereby giving protection which not merely the industry but our scheme of national defense needed."

———— :: ————

Tariff Free List and the Public Good

The reason usually advanced for placing some products on the free list is that those products are used in the public good. Practically all scientific instruments are used in the public good—in education, in research and in public health.

In the schools, colleges and museums, instruments are used for the teaching of science; in the laboratories and research institutes, instruments are necessary for the work of developing new products and utilizing waste materials; in public health, instruments are used to analyse samples and diagnose diseases from which the treatment is made, contageous diseases are identified and quarantines established.

Any argument that would apply to education, will apply equally well to research and public health. If all American products used in the public good are to be put on the free list, the protective tariff policy will apply only to products not used in the public good—and how many of these are there?

———— ::

Leeds & Northrup Company announces the appointment of Bradshaw & Company as exclusive sales agents for L & N metered combustion control apparatus in the Pittsburgh and Cleveland area including Western Pennsylvania, Eastern Ohio, Western New York and the state of West Virginia.

The Proposed Tariff and Instruments

Richard Rimbach

IN the March 29th and April 5th issues of SCIENCE there appeared advertisements of foreign scientific instrument manufacturers, which attack the proposed tariff on imported scientific instruments. These (reproduced on the following pages) strike the editor as being an unfounded reflection on the American scientific instrument industry.

As some of the statements made in these advertisements are not in accord with the facts and tend to give the instrument user a false impression of the purpose and results of the proposed tariff, the following facts are submitted.

These advertisements, which are very similar in general tone, state that the proposed tariff "may soon double the price of all scientific apparatus." Similar predictions were made in 1919 when a pamphlet signed "Friends of Science" was distributed throughout America by foreign manufacturers.

The "Friends of Science" Circular said that the 1922 Tariff would promptly result in manufacturers advancing their prices, and domestic instruments will reach a level of price to cause further serious concern to the teaching institution, with the result of retarding scientific progress.

The facts set forth in the following editorial in Industrial and Engineering Chemistry, April 1929, show that just the reverse has happened.

The American Economist, January 7, 1921, exposed the "Friends of Science" Circular in an article entitled "Propoganda for German Instruments," in which it said:

> "If the instigators of this circular were as much interested in the advancement of science and education as they would have us believe they are, then why make an anonymous plea?
>
> The fact is, more likely, the authors of the above propaganda are importers of microscopes and kindred instruments, who are thriving at the expense of American labor. Unless the domestic production is given the benefit of protection, the Germans will have full control of the market, the domestic industry having been wiped out of existence. Prices will then rise anad educational, scientific and philisophical institutions will pay more."

The statement is made that an increase in duty had been asked for on Microscopes and accessories, etc. This is contrary to the facts. The exact words of the American instrument industries' recommendation are:

> That "Sextants, octants, photographic and projection lenses, opera and field glasses, telescopes, **microscopes and other optical instruments,"** be classified under paragraph 228 at 45% duty exactly as they have been classified for the last seven years, and were classified in the 1909 tariff.

PROPOSED TARIFF and ITS RESULTS!

"It may soon double the price of all scientific apparatus"

Applications have been made by domestic manufacturers of scientific instruments with the Ways and Means Committee, Washington, D. C., for *an increase in duty on practically all imported scientific apparatus.* This list of scientific instruments is too lengthy to be given in detail but includes such items as: Microscopes and accessories, haemacytometers and accessories; magnifiers and readers; projection apparatus and parts; photomiero cameras and field glasses; telescopes and accessories; colorimeters and accessories; saccharimeters and accessories; spectroscopes and accessories.

Recommendation has furthermore been made that duty be assessed on a basis of U. S. value instead of the present method.

This innocent appearing change, if adopted, will materially increase ***the amount of duty to be paid in the future.*** It is evident therefore, that purchase of imported scientific instruments would become prohibitive.

The Tariff Act of 1922 did *two* things:

(1) ***Eliminated all duty-free importation of scientific equipment for education and research.***

(2) It increased *at* the same time duties from **25%** to **45%** on microscopes, colorimeters, refractometers, spectroscopes, etc., and on practically all scientific equipment.

If the new tariff act becomes effective, based upon the recommendations advanced by a few manufacturers,

THIS IS EVIDENT:

(1) Those scientific instruments now in daily use in our foremost and leading research laboratories, manufactured by Carl Zeiss, Ernst Leitz, Adam Hilger, Schmidt & Haensch, Fuess, Stoe, Max Kohl, Sartorius, Jung, R. J. Beck, W. Watson & Sons and many others will practically be eliminated from the U. S. market.

(2) Prices for domestic microscopes and accessories, colorimeters, refractometers, spectroscopes and hundreds of allied instruments will doubtless increase considerably.

(3) All imported scientific equipment will become prohibitive in price, even in such instances where no similar apparatus is manufactured in the U. S. A.

"A tax on Research and Science"

(4) Competition in the purchase of scientific instruments will be greatly restricted, favoring a few manufacturers and *creating a monopoly*, with its resulting price inflation.

(5) Science, in all its branches, will be penalized and will bear the brunt of any proposed tariff increases.

A situation favoring only a few, with its disturbing and distressing influences upon science, research, education and industry *should be opposed from its very inception* by those directly concerned and by all others interested in Science and Research.

It is vital to every educational institution, from public school to university, and to every scientist, educator and student, to oppose by every possible means any increase of duty on scientific instruments or the adoption of a new mode of valuation.

THE EDUCATIONAL BUYERS' ASSOCIATION, representing the purchasing authorities of practically every college and university in the United States, has submitted its brief to the Ways and Means Committee and to the Senate Finance Committee, Washington, D. C., *definitely opposing any increase of tariff rates on scientific apparatus.* Moreover the Association recommends the ***return of duty-free importation of scientific apparatus.***

THE AMERICAN ASSOCIATION OF MUSEUMS has already filed its brief with the Ways and Means Committee, and the *PHILADELPHIA ACADEMY OF NATURAL SCIENCE*, a museum and research institute, has taken the same attitude ***"as being definitely opposed to the levying of duty*** *on scientific instruments to scientific institutions engaged in direct research."*

In a similar manner, the *BOARD OF TRUSTEES OF THE AMERICAN MEDICAL ASSOCIATION* has filed protest with the Ways and Means Committee as being opposed to any increase in duty on surgical instruments.

Scientific workers and faculty members interested in this matter as individuals or as organizations, and officers of educational institutions, hospitals, museums, etc., if they desire to avoid the payment of such increased prices for scientific equipments as may reasonably be expected from the proposed advance in duties, *will do well to file protest against any increase of tariff rates or change of method in assessment of duty on scientific equipments relative to Paragraph 228, Paragraph 359, Paragraph 360 and Paragraph 1453 of the Tariff Act of 1922.*

The foregoing protests indicate a wide-spread opposition and resentment to a most unreasonable tax on science and education. To prevent the approaching catastrophe, this movement must have the undivided support of every scientist.

Address all communications *at once to:*

HON. WILLIS C. HAWLEY, Chairman,
Committee on Ways and Means,
Washington, D. C.

HON. REED SMOOT, Chairman,
Senate Finance Committee,
Washington, D. C.

and to Your Senator and Congressman.

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RECEIVED

TARIFF

Prior to 1922 the duty on scientific instruments was 25%, with a provision for duty free importations by educational, etc., institutions.

The tariff law of 1922 increased the duty to 45%, and abolished duty free importation.

At present a determined effort is being made to increase the duty further, even up to 60%, and to change the valuation system which will increase the duty still more.

Higher Duty Means Higher Prices

for the domestic product as well as for the imported one. The domestic manufacturer, having already in the present rate a more than ample protection, would have such a margin to play with, that competition of foreign-made instruments in this country would become almost impossible. Imported instruments on account of their relatively high prices have maintained themselves on the market with difficulty. Generally speaking they have sales possibilities only if they are of obviously better quality than competing domestic instruments, or if there are no similar domestic instruments. A still higher duty may make importation practically prohibitive and establish a monopoly for the small group of domestic manufacturers.

Among others, the following organizations have protested against the proposed changes in the tariff:

The Purchasing Agents of Universities and Colleges have filed a brief both with the Ways and Means Committee and the Senate Finance Committee asking for duty free importation for educational institutions. Referring to the present Tariff Act they say: "It is not exaggerating in the least to state that education is being taxed, a condition which is universally accepted as being a deterrent to education advancement."

The American Association of Museums filed a brief also asking for the restitution of duty free entry, quoting from a letter of the Philadelphia Academy of Natural Sciences, "The payment of duty on scientific instruments is to us a very serious matter. Inasmuch as in many cases instruments of similar character are not produced in America, the question of competition does not necessarily enter into the situation. In consequence we feel called upon to state our proposition very definitely as opposed to the levying of duty on scientific instruments engaged in direct research."

The American Medical Association has similarly "filed a protest with the Committee on Ways and Means against the proposed increase in the duty on surgical instruments. Physicians interested in this matter as individuals or as organizations, and the responsible officers of hospitals, if they desire to avoid the payment of such increased prices for surgical instruments as may reasonably be expected from the proposed increase in the duty on such instruments, will do well to file protest with the Committee on Ways and Means of the House of Representatives and with their respective Representatives."

Similar protests have been filed by the American Hospital Organization.

Scientists and organizations who are opposed to a further increase in duty may send their protests to the Committee on Ways and Means in whose hands the matter is at present, and later to the Senate Finance Committee, also to the Representatives and Senators of their districts.

The respective paragraphs of the present tariff law of 1922 are:

Schedule 2	Paragraph 228,	dealing with optical instruments.
" 3	" 359,	dealing with surgical, etc., instruments.
" 3	" 360,	dealing with "philosophical, scientific and laboratory instruments and apparatus, etc."

CARL ZEISS, Inc., 485 Fifth Avenue, New York

This advertisement states further that "Recommendation has furthermore been made that duty be assessed on a basis of U. S. value instead of the present method." The American scientific instrument industry never made such a recommendation.

Under the caption "THIS IS EVIDENT," the foreign advertisement then lists five things, which will supposedly happen, if the new tariff act becomes effective. These are considered in sequence below.

1. The admitted purpose of the tariff is to permit the manufacturer of a country to overcome unfair competition due to lower labor charges, depreciated currency, Government subsidies, cartels and other artificial advantages.

The names of the three English firms—Adam Hilger, R. J. Beck

and W. Watson & Sons are drawn in with the German firms. In England scientific instruments and apparatus are classified in their Tariff as "Key Industry Goods" and carry 50% duty, the highest ad valorem duty in their entire tariff—they make no exceptions.

When the War came the English exacted a promise of protection for the scientific instrument industry which they would have to develop—that promise has been redeemed. The Americans did not ask for promises, they went ahead and developed the industry.

The following is extracted from an editorial in the INSTRUMENT WORLD (an English Instrument publication):

> **SAFEGUARDING AND SCIENTIFIC INSTRUMENTS**
>
> The procedure to which the label "Safeguarding" is applied has been the subject of many warm discussions by industrialists, economists and politicians. An admirable review of the whole matter has recently been published in the TIMES TRADE AND ENGINEERING SUPPLEMENT.
>
> The Safeguarding of Industries Act, 1921, had two objects. One was the safeguarding of a definite list of so-called "key industries"; the second was to make provision against the effects of the depreciation of currencies of certain foreign countries.
>
> Among those products safeguarded were, of course: optical glass, optical elements and instruments, scientific and lamp-blown glassware; laboratory porcelain, scientific instruments, gauges, wireless valves and vacuum tubes.
>
> Discussing the vital question—What is a Key Industry?—the writer of the TIMES articles says, of instruments in particular:
>
> "The vital importance of optical instruments and the optical glass and elements required in their manufacture, for the military, naval, and air forces, and for every kind of scientific and medical research and the supervision of industrial processes, needs no demonstration. The fact that before the War nine-tenths of the optical glass used in this country (England) was imported from the Continent, and that the British optical instrument industry, though very efficient, was so limited in range and output that there was very great difficulty in supplying the requirements of the Forces, are sufficient evidence of the need for some aid to both branches of the industry."
>
> Again: "The schedule heading 'scientific instruments' covers a wide range of non-optical instruments which are absolutely essential for the fighting forces, and are of primary importance also for physical and chemical research work and in many industrial operations.
>
> It was undoubtedly in the minds of those who framed the 1921 Act to select for safeguarding industries of high future potentialities. They realized—perhaps even more clearly than the members of those industries selected for safeguarding—that future prosperity and progress would very largely depend on the virility and both technical and financial advancement of the "key industries." How far the passage of time has materialized the hopes entertained must be left for others to judge.—Instrument World, London, Jan. 1929, page 260.

2. Prices for domestic instruments are not influenced by the tariff. The 1922 tariff increased the duties and since then the American prices have been reduced, as is evidenced by th following editorial in the April issue of INDUSTRIAL & ENGINEERING CHEMISTRY.

The man who buys a quadruple effect, centrifugal of high capacity, a diffusion battery, or a list of modern filter presses may be inclined to pass by as unimportant laboratory equipment and supplies. But the successful operation of plant equipment practically always depends upon laboratory control, and new equipment is both designed and installed as the result of problems laboriously worked out with laboratory equipment. It seems fitting, therefore, to call attention to contributions which have been made of late to the progress of chemistry in America by the makers of scientific apparatus.

This is not the place to discuss new pieces of equipment or new sources of supply, but we do wish to point out that the cost of laboratory equipment to the user is lower now than it was before the Tariff Act of 1922 was passed. Comparing the prices of 1920 with those of 1929, it is found that, with a quality and accuracy higher than at the earlier date, the average price of chemical glassware, such as "resistance" glass beakers and flasks, burettes, cylinders, pipettes, separatory and chemical funnels, is 24% lower. Glassware with a low coefficient of expansion is sold in quantities for 5% less, and smaller quantities than formerly enjoy this reduction.

In metal apparatus, where substantial improvements have been made in design and construction, the prices of one manufacturer are 27.7% lower than in 1920, while the average of 1000 different items taken from another list shows a 17.4% decrease, and only 5% of the lot show an increase in price. In all these cases the higher cost was due to expensive improvements.

In another shop, labor-saving devices have enabled better apparatus to be sold at prices which show an average decrease of 23.2% in selling prices. In chemical porcelain ware a flat 40% reduction has been made in the sales prices applying to over 400 different items. In optical instruments many have been completely redesigned and so greatly improved that a comparison between 1920 and 1929 is impossible. If these new non-comparative items are eliminated and the computation is made according to sales as a whole, there is a decrease of 8.4%. For example, a microscope sold in large numbers is now priced at $120, as compared with $132 in 1920. If the new types of instruments are included in the calculations, an increase of but 5% in the sales price of the entire list is shown, notwithstanding a wage increase of 14.5% during the period under discussion. In electrical heating appliances, a decrease of 18.1% is registered, though here again marked improvements have been made in design and construction.

One hundred and seven important chemical reagents show a decline of 21.4% in price, while another list of 600 chemicals shows a reduction of 26%. The latter manufacturer listed 750 chemicals in 1920 and now lists 2450. The comparison as above is not the complete picture, for some of these items can only be sold in small quantities, are of very little interest to chemists as a whole, and because of their limited sale show small change in price. However, this may be just as important an item in the progress of the science as one which can be sold in large quantities and on which the price can therefore be lower. It is estimated that a weighted average of this list of chemical reagents would show a price reduction of more than 50% as compared with current prices in 1920. The price of the entire line of domestic laboratory equipment and supplies has been reduced 18% since 1920 and this has forced a reduction in the prices of items imported from Europe. In many cases today the "Auslander" prices to America are lower than the domestic prices in the exporting country which is the reverse of the policy prior to 1914.

> All of these data are interesting as showing the effort of the scientific apparatus maker and the manufacturer of reagent and research chemicals in America to deal fairly with their customers, to make improvements wherever possible, and not to lose sight of their responsibility.—Industrial & Engineering Chemistry, April 1929, Page 298.

3. At the present time there are but few instruments which are not manufactured here. The American manufacturers are able to make instruments equal to the best foreign product.

The following is an extract from a statement of Mr. Benedict Crowell, Assistant Secretary of War during the late war:

> At the present time American manufacturers are in a position to make instruments of precision equal to the best European product, and the industry will continue, provided there is an adequate market for its product.

4. No monopoly will be created, as there are a large number of instrument manufacturers in this country. Over 200 manufacturers, both large and small, are listed in INSTRUMENTS' files.

5. Our American protective tariff is called "a tax on research" whereas the American Scientific instrument industry is recognized by the research workers as essential to their work. Dr. E. R. Weidlein, Director of The Mellon Institute of Industrial Research, in a letter to the Ways and Means Committee, says: "We depend constantly upon these home industries to meet our daily necessities—I do not advise the extension of duty-free privileges." Another Research Director, J. V. N. Door, says that the duty-free importation of scientific instruments would create a barrier to scientific research in America by depriving its laboratories of a domestic source of supply for the appliances with which to work. Dr. E. C. K. Mees, Director of Research, Eastman Kodak Company, in a letter to the Ways and Means Committee, states: "As the Director of a large research laboratory who is extremely interested in seeing research prosper in this country, I respectfully beg to advise that the duty-free privilege suggested be not extended in the new tariff bill now pending." This same attitude is held by many research men throughout the country.

The advertisement states that the Educational Buyers' Association have definitely opposed an increase in tariff rates and recommend a return to duty-free importation of scientific apparatus. Many "Educational Buyers" appreciate that spending on the American basis is consistent with the privilege of earning and receiving on the American basis. Several Members of that Association have already protested against duty-free importation.

The total annual expenditures of educational institutes for scientific equipment, when compared to building maintenance, salaries, libraries, athletics, etc., represents so small a percentage of the total annual expenditures, that were all expenditures for scientific apparatus curtailed the reduction in total expenditures would be inappreciable.

The John Price Jones Corporation reports gifts to educational institutions of 129 million dollars in 12 months (1928). Surely the American protective tariff policy contributed to the prosperity that made there gifts possible. To put the products of a particular group of American workmen on a duty-free basis means that those workmen must sell their time on the lower foreign basis or obtain other employment. If the idea of asking particular groups of Americans to sell their services on a duty-free basis is to effect a material saving to educational institutions, the instrument makers would be about the last group called upon in the order of expenditures.

Major R. W. Pinger, representing the War Department of the United States in open hearing of the Ways and Means Committee stated:

> In the seven years which have followed (1922) the scientific instrument industry has become more efficient. However nothing has occured which makes it one whit less important to the military, and for that matter, naval, protection of the country. On the contrary, the scientific progress in the martial arts emphasizes more than ever our dependence thereon. It is believed that the **RESTORATION OF THE DUTY-FREE PRIVILEGE TO UNIVERSITIES—WOULD BE OF SERIOUS DETRIMENT TO THE NATIONAL DEFENSE.**

The advertisement also states that the "American Association of Museums had filed a brief opposing duty on instruments for scientific institutions engaged in direct research." They did state an intention to do so, but when they learned the facts they filed a brief saying that they did not advocate free entry for research. A copy of the paragraph added to the brief with reference to Paragraph 1706 of the free list follows:

> In order to correct a misunderstanding that has developed, we call attention to the fact that we do not here or elsewhere advocate free entry of optical or other instruments for purposes of research by institutions engaged in research. We did intend to offer a suggestion to the effect, but we withdrew the point. The suggestion to which reference is made in the foregoing two paragraphs, namely, that of free entry for technology exhibits, is obviously a different matter altogether, and we believe that it is one of no consequence to the instrument industry.
>
> AMERICAN ASSOCIATION OF MUSEUMS.

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The Henry L. Scott Company, makers of testing machines, announces the addition to their organization of William H. Whitcomb. Mr. Whitcomb comes to the Scott staff after 12 years spent as Director of Central Laboratory in the Footwear Division of the U. S. Rubber Company at New Haven, Connecticut. At the latter plant Mr. Whitcomb supervised and directed the chemical and physical testing of materials, the development and testing of compounds, the control of testing of finished goods for quality of manufacture, and the inspection and testing of fabrics.

through an advertising campaign in trade papers reaching selected industries, you can undoubtedly reach thousands of readers, who are not and never will be concerned with instruments and devices for measurement, inspection and control. You pay a needlessly high price for the interest that is there and you make a decidedly less effective impression on that interest than if you used a less expensive campaign. INSTRUMENTS reaches the concentrated interest in this subject. Your message in its advertising pages will reach the right man, in the right plant, at the right time.

INSTRUMENTS is published on the fifteenth of each month. The advertising forms close on the fifth of the same month.

Space reservations, copy and cuts for advertisements to appear in the June issue should reach us not later than June fifth.

INSTRUMENTS PUBLISHING COMPANY
1117 Wolfendale Street **Pittsburgh, Penna**

Laboratory Apparatus as a Means of Works Control**

*Arthur Schroder**

FOR the last generation, technical control has had for its milestones the development and standardization of scientific testing methods and apparatus. A survey of the developments in the technical control of products, both in the plant and through the laboratory, shows certain marked tendencies:

1. The producing and consuming public are becoming "scientific minded," and believe in testing as a means of establishing a common basis of exchange of commodities.

2. Works control and laboratory equipment is becoming more and more simplified and standardized.

3. There is an ever increasing utilization of the measurement of *one specific physical property of a product as an index of the quality of that product in each step of its manufacture*. These tendencies will be briefly considered and then some of the more prominent laboratory apparatus will be mentioned.

A "Scientific Minded" Public. The World War probably did more for the advancement of the manufacture of scientific apparatus in the United States than did anything else. Our sudden realization of our almost utter dependence upon foreign sources for testing equipment made us aware of the need of such an industry within our own borders. As a result of this, the average man in the street has become interested in science, and as a sequel to this, has carried his interest into his business. Where once a laboratory was considered, like insurance, a necessary evil thrust upon an organization by a manager who wanted to ride a hobby, today we find the average consumer demanding a uniformity of product which can be guaranteed only by scientific control of production. The publicity given The Chemical Warfare Service during and immediately after the War, has awakened public interest in chemistry and allied sciences. This has led to the introduction of laboratories into industries in which they were previously unknown.

From a recent survey there are in the United States, about 5000 industrial laboratories, and about 1200 public health laboratories controlling sanitation through water and food analysis. In addition to these, some 2500 colleges and about 8000 high schools are giving courses in chemistry and allied sciences.

The work carried on in these laboratories is permeating the public to the extent that it now realizes what chemistry can do, and is just

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*Director of Technical Science, Fisher Scientific Company.
**Paper before the Students Course at Twelfth Exposition of Chemical Industries.

beginning to hope, and almost expect, that it can do anything.

With this scientific interest on the part of the public has come an increasing realization on the part of producers, of the need of a control laboratory, and also a more recent realization that the *laboratory must be responsible for the quality of production.*

It was not so long ago that technical supplies were frequently specified by the laboratory and then purchased on the open market through a purchasing department, which was usually under pressure to buy equipment at the cheapest possible price. Rarely did that department realize the intricacies involved in the manufacture of scientific testing equipment. Material was purchased by name and price only, regardless of the accuracy necessarily involved in a particular piece of apparatus. The Purchasing Department could hardly be expected to act otherwise. In order to meet this condition of decreased selling price, manufacturers of scientific apparatus were compelled to reduce costs wherever possible and, sorry to say, sometimes saved to the detriment of the ultimate utility of the apparatus. This brought about a condition which was almost intolerable from the technical control viewpoint.

Within the last five years a marked change on the part of many users in demanding specific apparatus, and on the part of the manufacturer in building up corresponding specifications has been observed. WHEN DEFINITE SPECIFICATIONS ARE LAID DOWN FOR VARIOUS TESTS, THE ACCURACY AND REPRODUCIBILITY OF THE TESTS ARE INCREASED. *But,* by standardizing the tests and the apparatus along with the tests, the cost of the apparatus is greatly reduced because specially made types are no longer necessary and larger production can be employed. Now, the tendency is to incorporate in specifications for equipment, only the essentials and leave the unessentials to the manufacturer for his solution.

With the increasing number of laboratories springing up, and with this changed attitude, has come a need of a clearing-house for information on methods of testing and testing equipment. This need is being met by the growth of an ever increasing number of technical associations. There are now something like 250 Trade Associations operating technical laboratories of one sort or another, for the mutual benefit of their members. Needless to say, the American Society for Testing Materials is the Father of them all.

These technical societies are a very valuable source of information for the man just starting his career. Official methods are always available. They represent the work of numerous experts in the field, have been as simplified as possible in view of the accuracy necessary, and constitute the universal language of business transactions. I would most heartily recommend that each of you enroll in some of these. The American Chemical Society and the American Society for Testing Materials are, of course, absolute necessities. In addition to these, one

trade association in your particular line will give you all the technical and also social, contacts you will probably require for some years to come.

An idea of the scope of the activities of these societes can be obtained from a report of the American Society for Testing Materials[1], in which almost 2000 pages covering 340 standard specifications have been published. Since that time some 200 more[2] are in the process of development. These cover everything from the testing of crude petroleum to a bar of finest special alloy steel. Both the apparatus and the methods to be used in testing cement, rubber, copper, non-ferrous alloys, asphalts, etc., all come in for their own groups of specifications. One can almost say, nothing can be purchased on the open market, without its having been tested some time during its production.

Simplification and Standardization of Testing Apparatus. As a result of the work of these various technical associations, has come a realization of the danger of duplication by various manufacturers or technical organizations and, consequently, an attempt is being made to simplify and standardize the method of test and the specification for the apparatus to be used. This can be amply illustrated by a reference to such a simple instrument as a thermometer. Commercial testing laboratories were required to have 150 to 200 different types of thermometers in order to be equipped for testing the average run of technical products. Today only about 30 different types are required. About five years ago there were over 40 control types of gas apparatus on the market, which types were considered more or less acceptable and standard. A study of these soon showed that there was a needless duplication of equipment, all designed to accomplish the same ultimate results. This meant that a manufacturer would have to carry in stock all parts for the 40 types of gas apparatus and be ready to supply replace units at a moment's notice. As a result of standardization and simplification, a complete gas analyzing apparatus for almost any gas can be assembled in about five minutes from standard parts carried on the shelves of the manufacturers.

The American Chemical Society has had a committee investigating the various apparatus on the market and periodically submits reports on its progress, recommending what apparatus in their estimation is becoming obsolete and should be dropped from the trade catalogues. Incidentally, chemicals are also being investigated with a view to improving their quality. These reports are published in the Society's journals and give one a very good idea of what is available. As a result of such standardization, the appliances retained have been improved, manufactured in larger quantities, and their prices materially reduced.

With the enormous increase in specifications for products, and the

1. A.S.T.M. Year Book, August, 1928
2. A.S.T.M. Tentative Standards, 1928

consequent increase in time consumed in testing, the producer has reduced the testing of products to an absolute minimum. This has led to the development of highly specialized testing apparatus. There is an increasing utilization of the measurement of one specific property of a substance involved in production, as a test of the quality of the product. This has invariably meant the development of an instrument designed to measure only one property of a substance and do this in a minimum of time, and in the most convenient manner. Where long analyses of products required several days, today the entire output of a plant can be controlled by a single instrument involving very little technical skill, and requiring only a few minutes for a complete test. Wherever possible, the test itself is made automatically. This is probably one of the most outstanding developments in the laboratory and works control apparatus in the last generation. Some of these will be discussed later on.

Another factor in the development of works control and laboratory testing apparatus is the new attitude of cooperation between the manufacturers and users of testing equipment. A few years ago the laboratory apparatus industry relied for its consumption, upon the activities of salesmen, and an excessively heavy advertising budget. Today we see, instead of the salesman, entire forces of technically trained men, each one a specialist in his own line, ever ready to meet the customer in his own works, and help him solve his problem as it arises.

Such men you will find are ever ready to help you with your laboratory equipment problems. Call upon them when necessary. You will find them well versed in their lines and very willing to help. They can frequently save you much time and money.

A discussion of this type would not be complete without a reference to some of the fine instruments recently developed. Obviously all cannot be described. Those which have been chosen are typical of their field, and are grouped according to the function they perform as control instruments.

Colorimeters. Colorimetric analysis, color analysis and color fading have recently been receiving much emphasis. Among the laboratory colorimeters[3] in prominence today, from a works control viewpoint are (1) the liquid depth colorimeters like the Kennicott-Campbell-Hurley and the biological type made by Bausch and Lomb and Spencer Lens Company; The Saybolt, the Robinson, etc. (2) The standard glass type like the Lovibond and Union. These are all essentially color comparators, in which the unknown color is matched against an arbitrary standard. In all these, the tendency is to employ glass standards wherever possible, so as to minimize possible error due to fading of the standards.

The color analyzers being used today are the Ives Tint-Photometer with its primary glass standards, and the Harvey Automatic Spectro-

3. F. D. Snell "Colorimetric Analysis."

Analyzer, which employs a light sensitive cell. Each has its field and own set of followers. Each machine has its advantages but limited production has somewhat limited their use in routine laboratories. The degree of blackness or grayness of a cloth or pigment can be determined either alone or in conjunction with an undertone of one of the primary colors in the Ives Instrument, while grayness can now be indexed on the Johnson Nigrometer[4]. This late arrival has already established itself in the paint, enamel, ink and carbon black industries. Sheen, which has so often interfered with color analysis, is now being recognized as a separate property of materials and is being measured and studied on the Ingersol Glarimeter[5]. Cloth, silks, crystals, celluloids, paints, enamels, and glasses are all being controlled by means of these instruments. New instruments are still needed to solve color differences which can now be detected by the eye, but for which there is at present no measuring instrument. Perhaps, when the fundamental principles of colorimetry are better understood, such instruments will be forthcoming.

The fastness of dyes on clothing, silks, tapestries, and even the color of glasses and enamels is being controlled, and still studied through the use of the ultra-violet and arc lamps. Rubber is now artificially aged with these so as to foretell its probable length of life.

Humidity Controllers. Industrial Humidity Controllers have been available for some time. Several companies are now in the field. Their machines have come to stay. The paper, paint, textile, clay and lacquer industries rely upon them as the governor of their rate of production. Very recently a small laboratory size humidifier and indicator has appeared. It is so new one can hardly foretell its many uses.

Heat Indicators and Controllers. In the laboratory, heat measurements have finally settled to a definite, reliable basis.

Thermometers have become pretty well standardized within the last few years. Thirty years ago, almost any calibrated glass tube containing an expanding liquid was considered satisfactory. About twenty years ago, the fundamental principles underlying thermometry began to be studied and thermometer manufacture was reformed. Theory rather than use, was emphasized and specifications for thermometers were made by the thousands. Specifications became so numerous that while fulfilling some, others just had to be ignored if commercial production were to be considered. Meantime, the number of thermometers specified increased by leaps and bounds. Conditions become so bad that manufacturers became desperate.

Thanks to the cooperation between the A.S.T.M.[6], the International Congress for Testing Materials[7], the Bureau of Standards[8], and some of the manufacturers, the theoretical aspects have been viewed in the

4. Paint, Oil and Chemical Review, July 5, 1928, Pg. 14.
5. Paper Industry, March 1921, Journal American Ceramic Society, Feb. 1927.
6. A.S.T.M. Standards, 1927, Part II, 996.
7. International Congress for Testing Materials 1927, II, 689.
8. U. S. Bureau of Standards, Circulars Nos. 8 and 66.

light of manufacturing difficulties and reliable thermometers have evolved. The evolution is still continuing. Specifications are still being made as necessary, but the number of thermometers being specified is gradually growing smaller and smaller.

There has been one very interesting recent development in thermometers. A quartz thermometer[9], filled with gallium or a mercury alloy, for use up to about 1000° C., has been developed by the General Electric Company, although as yet it is not being produced commercially. This fills the gap between the cheaper glass thermometers for low temperature range, and the more expensive thermocouple and optical pyrometers for the higher ranges.

The thermocouple still holds the field for wide-range, long-distance indicating and recording instruments. An interesting development has been the harnessing of the feeble current generated in a thermocouple to warn the operator by lights, bells or other signals, of the conditions of the unit at all times and to control through relays, an entire plant. Most of the instruments on the market are direct reading, very reliable and reasonably cheap, both as to initial cost and routine upkeep. The old standby, the platinum resistance thermocouple, still maintains its former prestige as reference standard, but is rapidly being displaced by the base metal thermocouple for control purposes. Standard samples of Tin, Zinc, Aluminum, Copper, etc., with known melting points are now obtainable from the U. S. Bureau of Standards. These are recommended as standards for the calibration of thermometers and pyrometers.

The pressure spring type of thermometer (the vapor pressure, gas pressure and liquid pressure types) is rapidly invading the field of the thermocouple pyrometer, but because of its nature, is somewhat restricted in its range. New models of radiation pyrometers are always appearing. Their tendency to give false readings, when used by inexperienced operators, has brought this type into some disrepute. However, education of the user by the manufacturer is gradually improving conditions.

Optical pyrometers of the disappearing filament type, occupy the predominant position for the higher ranges of temperature and have been accepted as standards. One of these is direct reading. Their one drawback, that of requiring black body radiation conditions for optimun accuracy, still limits their usefulness in some respects. Manufacturers realizing this have issued Tables of Corrections to be applied to take care of the various conditions obtaining in works control. But, for duplicating satisfactory results, the use of the Correction Table can be eliminated.

Pyrometer upkeep has developed a pyrometer engineer—a man, solely responsible for maintenance, accuracy and calibration. Most manufac-

9. Transactions, Illuminating Engineering Soc. Vol. 21, No. 6, 1926.

turers are employing trained men in their service departments and distribution centers throughout the country. They can usually be called upon in emergencies.

There is yet, however, a definite need for a cheap, accurate, rugged temperature indicator covering a range of about 500° C. up, which would not have the disadvantages of the present types.

Liquid and Gas Meters. In liquid measurement we have seen many new instruments developed. Liquid depth, velocity, capacity, pressure and density meters are appearing in numbers. Most of them are direct reading, many are recording, some are dynamic, some static, some pneumatic and some electric. Almost any kind for any purpose is available.

Acidity and Alkalinity Meters. Hydrogen Ion Concentration and Conductivity Meters and recorders have only recently come into prominence. Paper, electroplating, sewage disposal, water purification, leather tanning, textile and foods are all being studied with a view to ultimate automatic control. Aside from the increased value of more uniform products due to the use of these instruments, the saving of material due to their installation, has paid for their original cost many times over.

For laboratory steel analysis, the hydrogen-electrode titration outfits still hold the field against all newcomers. In other analyses, the quinhydrone electrode is preferred because it is less sensitive to "poisons," and other electrodes for specific conditions are being developed daily. Colorimetric pH Comparators employing liquid standards, are available for the entire range of pH. The tendency of the standards to fade, particularly in the strongly acid strongly alkaline ranges, has led to the gradual displacement of this type by one employing permanent non-fading glass standards. Convenient portable outfits in both types, are available in all ranges.

Viscosimeters. For viscosity control, the Saybolt Viscosimeter for lower ranges, and the Furol for slightly higher ranges, still are paramount. These can now be obtained in automatic models. For viscous materials like lacquers, paints, rubber cements, the Gardner-Holt Mobilometer[10] is a handy control unit. Plasticity measuring machines have appeared, but their use is still somewhat limited.

Scales and Balances. Uniformity of product always depends upon the relative weights of the ingredients. In the field of little things a new keyboard analytical balance, which looks somewhat like a typewriter, has made its appearance. This is a real timesaver for control weighings, differing from each other by fractions of a gram. For still finer weighings a micro balance, weighing to .001 mg. is in daily use in several laboratories.

Physico-Chemical and Physical Testing Apparatus. Physical chemistry has fostered the development of many fine instruments which are unfolding the mysteries of moleculer and atomic structure. Spectro-

10. The Laboratory, Vol. I, No. 3, 1928, Pg. 36.

scopes and spectrographs, polarimeters, surface tension meters, colloid mills, the ultra microscope and the X-ray machine, once the hobbies of our professors, are now in daily use. In the analysis of metals, a photomicrographic apparatus capable of giving very high magnification, is used to determine the crystal structure of steel products like mill rolls, auto axles, razor blades, etc., and serves as the final judge in metallurgy.

The fields of physical chemistry and physical testing have no definite line of demarkation, and so the chemist of the present finds himself frequently doing more physical testing than performing physico-chemical tests. This is very true in the metal industries. Compressibility and tensile strength, fatigue, elasticity, magnetic permeability, hardness, conductivity, capacitance, di-electric strength, corrosion and chemical resistance are all major properties determining the market value of products. For each of these there are now one or more standardized instruments. The entire field is relatively unexplored and offers fine opportunities for the young man just starting on his career. For those of you who care to look into this field, the Proceedings of the American Society for Testing Materials for the past few years, and a book of Batson and Hyde entitled "Mechanical Testing," will be very interesting.

Two outstanding developments of last year were the Knowles Glow Tube and Wensley's Robot[11]. By changing the capacity of a Knowles Tube, which looks like an overgrown radio bulb, relays are activated and limitless power can be controlled. In a recent demonstration a man waving his hand over the bulb in his office in the East, started an all electric rolling mill in Homestead, Pa. This same type of bulb controls the moisture content of paper. The Robot, based essentially on tuned radio circuits, responds to a sound of definite pitch and controls through relays, processes miles from the source of the sound. These are as yet in the experimental state, but who would dare predict what technical process could not be controlled by these almost human machines.

As new products are put on the market, the manufacturer is continually faced with the problem of finding means whereby those products can be controlled and tested.

Laboratory Glassware, Porcelain and Chemicals. In discussing control and laboratory apparatus, one cannot help but think of laboratory glassware and the chemicals which go to make up the bulk of the every day supplies of the chemist. In the perfection of these, great strides have been made. Foreign glassware, both graduated and ungraduated was considered the best until about 1914. Domestic production, suffering from lack of protection, was sadly discouraged and production limited to a very few lines. When thrown on our own resources, America just had to produce its own laboratory equipment or the very field equipment of our armed forces, which depended on this for its production and control, could not have been produced. Scientific

11. Worlds Work, Feb. 1929, Pg. 47.

education and public health activities could not have been continued. This sudden shortage proved a blessing in disguise.

Glassware was the first to require immediate attention. While the first produced in this country was not all we might have desired of it, it did tide us over until we could work out the details. Today we have a laboratory glassware industry, producing a chemical and heat resistant glass that compares very favorable with the best foreign ware. Graduated glassware: burettes, cylinders, pipettes, etc., are now made with the aid of new dividing and engraving machines, with a uniformity and accuracy never equaled abroad. Chemical porcelain ware, one of the very difficult products for America to develop because of relatively no experience in this line of production, has come through with high chemical, heat and mechanical shock resistance, wonderful uniformity of size and shape, and is now reaching a large scale production basis.

Before the World War, Germany was the only producer of special chemicals. Today, one American manufacturer alone makes 2450 different organic chemical reagents, hardly any one of which can be considered as having reached the commercial production stage, but each one virtually essential to chemical research or control in one phase or another.

Another manufacturer has put out a complete line of analyzed chemical reagents, of a degree of chemical purity on a par with the best foreign makes. Other companies are developing similar lines. Much has been already accomplished — much still remains to be done.

In spite of all development work prices have on the average, been reduced about 25% on organic and about 20% on organic chemicals. Porcelain itself has experienced a 40% reduction not very long ago. The entire line of laboratory equipment, in spite of the many improvements, is now about 18% cheaper than in 1920.

New developments must be devised. Frequently new materials must be developed. In all this, the manufacturer of such testing equipment is in a position to render real service. He develops the instruments which stand guard over the traffic of materials through the plant and mean profit or loss to the industry.

A word might be said about sources of information on the various types of apparatus and chemicals available. The first which comes to mind is the trade catalogue of which many are available. These are veritable store houses of information. Many contain, in addition to a description of the apparatus, a bibliography on the uses of the article. The National Research Council and "Instruments" conduct an information bureau from which much information can be obtained. The Chemical Catalogue, published by the Chemical Catalogue Company of New York City, is the telephone directory of sources of supplies. In addition to these the American Chemical Society publishes an analytical section in its journal, which is devoted entirely to laboratory methods

of analysis and the apparatus to be used in the methods recommended. There are also several magazines on apparatus regularly published. Among these should be mentioned the Journal of the Optical Society and Review of Scientific Instruments, and "Instruments."

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for Measurement, Inspection and Control

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Automatic Process Control Instruments*

Richard Rimbach

THE success of most industrial processes, especially in the chemical industries, depends upon the maintenance of certain conditions, as these conditions exert a pronounced influence upon the finished products. For years intensive research has been carried on in the laboratory to find the best set of conditions. In searching for these conditions it was frequently necessary to watch indicators and manually adjust valves constantly to obtain the desired results. The accurate and positive control of these conditions has become a major task of industry.

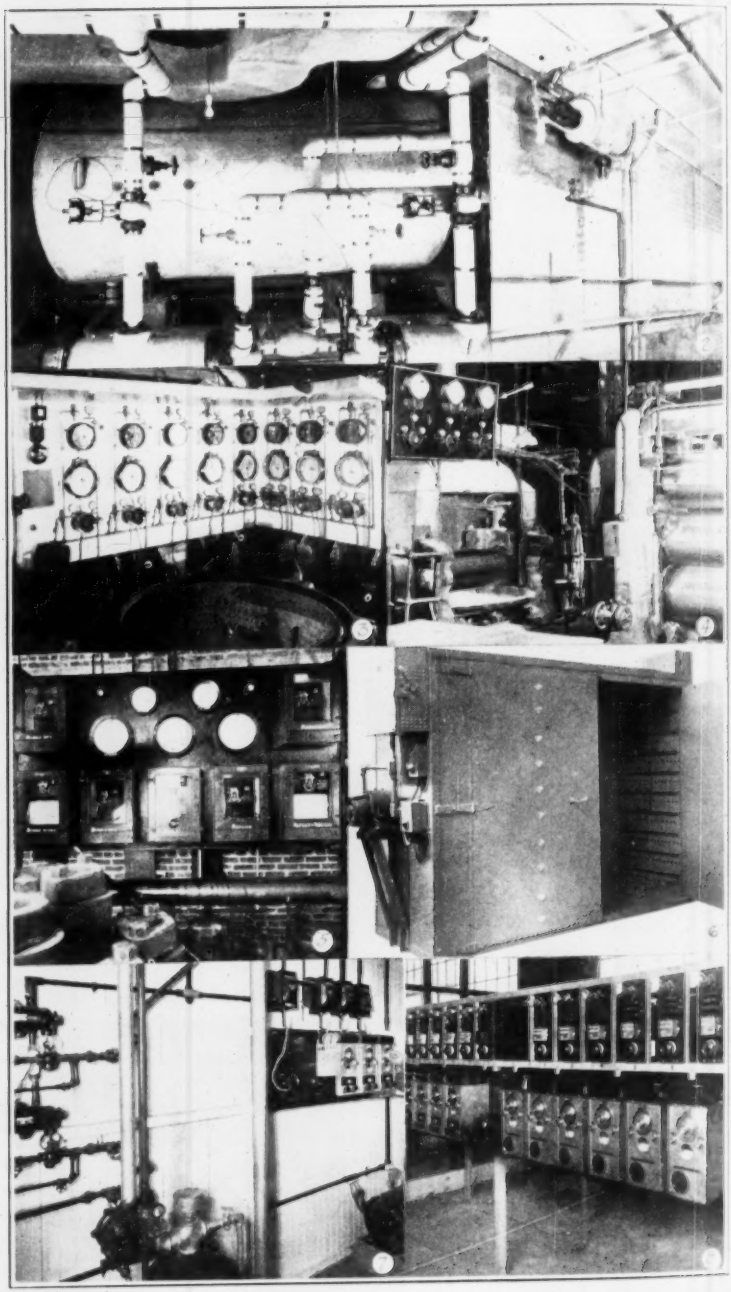
Manual control, at its best is unsatisfactory, inefficient, and inevitably dependent upon the human element. While it is, to be sure, better than no control at all, it cannot be depended upon day in and day out, or in emergencies.

The most expert operator, endowed with years of experience and aided by all the mechanical ingenuity available, can only compensate for variations in conditions when changes in these conditions have actually taken place and show themselves by changes in the indications of the indicating instrument. In the most efficient manual control of any process, the human element is of vital importance; consideration of the human element is eliminated by automatic process control. It permits the reproduction of the same conditions for each run and thereby assures a consistent and uniform product—day in and day out—month in and month out. The automatic controller will constantly and uniformly maintain at the same conditions; while with hand control, the operator may not be on the job at all times, and during his absence or oversight some changes may take place and the material in process seriously damaged.

Automatic regulation is essential to increase efficiency in manufacturing processes, particularly as regards the saving in time. It is now possible to dry and season lumber in months or days, where it formerly required years. In the manufacture of prepared foods it has materially shortened the time required for their preparation. In most of the big manufacturing problems, such as tanning and drying leather, the drying of lacquer and varnishes, the manufacture of soap, silk, wool and cotton goods, automatic control of certain conditions is all important to the production of a uniform product.

It should not be forgotten that the application of automatic process control usually results in the release of labor which can be used for other purposes. Increased cost of labor and increased demands for uniformity of product have widened the field for the use of automatic process control instruments and devices.

*Paper before the Students' Course at the Twelfth Exposition of Chemical Industries.



During the last few years automatic control of chemical processes has become very popular and extensive in use, due to the following advantages:

1. Conservation of fuel
2. Decreased labor costs
3. Increased production
4. Improved quality of production
5. Greater uniformity in quality, and
6. Decreased spoilage.

The conditions to be controlled are temperature, pressure, humidity, time, composition, weight and volume, flow, specific gravity, and liquid level. Controllers have been built to control these conditions singly or in various combinations.

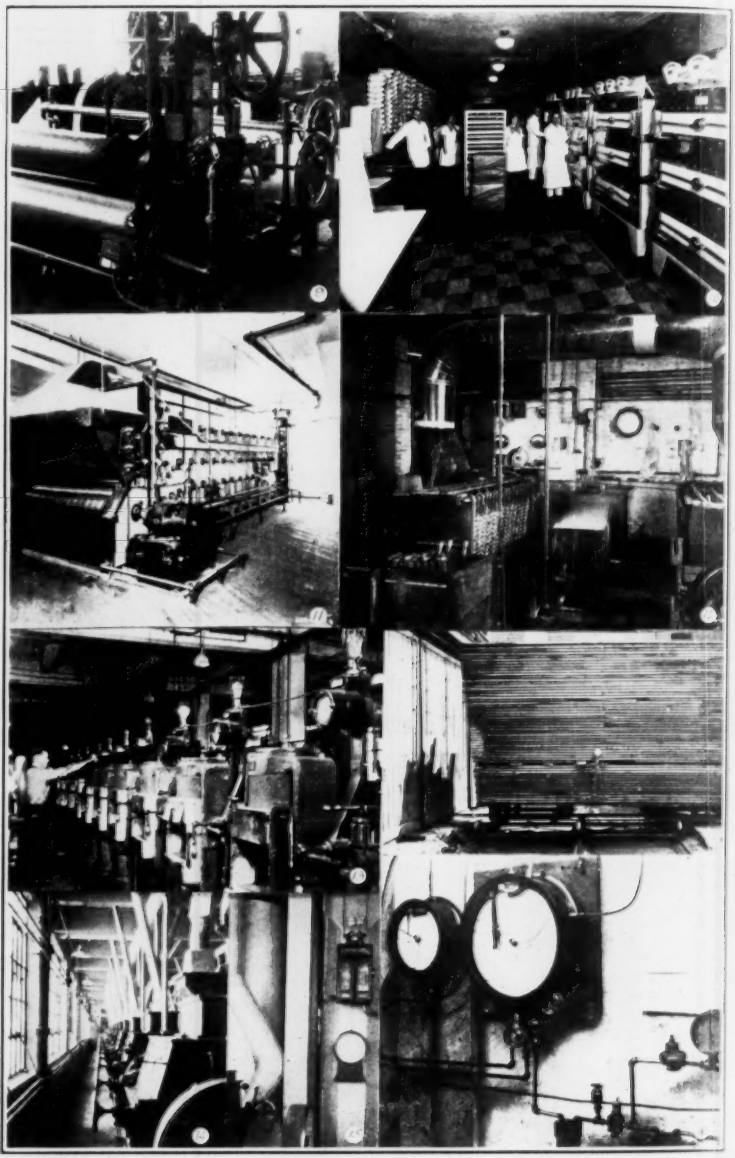
Some typical applications of automatic instruments and devices are shown in the following illustrations. These illustrations show the adaptability of automatic control to several typical processes. Specific applications can be readily imagined. It should be pointed out that the instruments shown by no means represent the only products of any one manufacturer, nor are they the only ones for the indicated purpose.

Temperature. Most of the processes in the chemical and allied industries depend on temperature control for their successful conduct. Heat is either consumed or generated and, in either case the prevention of excessive temperatures and the avoidance of insufficient temperatures are of vital importance. This can only be successfully accomplished by automatic temperature control.

Fig. 1 shows a temperature regulator controlling the temperature of service water heaters, while Fig. 2 shows a special controller for mixing steam and water.

A control board in a canning plant is shown in Fig. 3. In Fig. 4 are shown recording thermometers and temperature regulators on rubber mill calender rolls. The instruments shown in Fig. 5 record and control temperatures in oil plant bubble towers. The oven shown in Fig. 6 is automatically controlled and is applied to drying materials in a large color and pigment plant. The temperature controllers and motor-operated valves on a gas heated drying room are shown in Fig. 7 while Fig. 8 shows controllers on heat-treating furnaces. Fig. 9 shows a temperature control on a waxed paper machine. The switch is in the center of the illustration at the bottom. An automatic controller installation to control the temperature of electric ovens is shown in Fig. 10. Fig. 11 shows thermometer thermostats on baking ovens to maintain steady heating, while a temperature regulator applied to a chromium plating tank is seen in Fig. 12.

Time. Time controls can be used for every periodic operation, allowing a man to attend a greater number of operating units and assure greater uniformity in quality of product and eliminate spoilage. These instruments can make contacts at any predetermined interval, can con-



tinually repeat a contact for any interval, can control the starting and stopping of motors for controlling the time that best is applied to molded materials, etc.

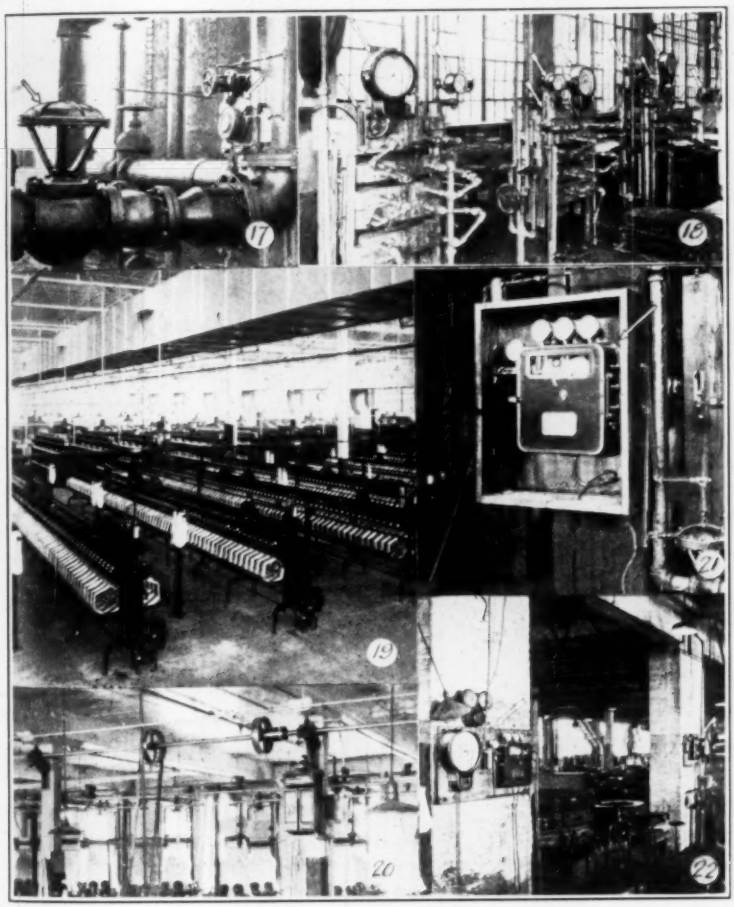
Fig. 13 is an illustration of this latter application. Bakelite, condensite,

and hard rubber are here made into the form of binding screws, distributor caps, knobs and dials for radio sets, etc.

Humidity. Many materials absorb water vapor in a considerable degree from the air—when the humidity in the air is high. Conversely, if the humidity of the surrounding air be low, these same substances give off their moisture.

Tobacco, wool, wood, cotton, silk, in fact, nearly everything is more or less hygroscopic, and the rate of the absorption or giving-up moisture varies with the relative humidity. With a uniform humidity it is possible to eliminate one of the many causes of variation in the weight of goods produced, not to mention overcoming many manufacturing difficulties.

A humidity controller in a flour mill is shown in Figs. 14 and 15. Fig. 14 illustrates the humidifying device while Fig. 15 is a view of the



controller. In Fig. 23 a very unusual controller to control the moisture of the stock in a paper mill is seen.

A comparatively new type of humidity controller of lumber is shown in the photograph above Fig. 16. The automatic scale which weighs the sample in the kiln is shown mounted on the car. The weight of the sample, in terms of moisture content, is recorded outside the kiln on the instruments shown in Fig. 16. This device automatically controls the drying schedule in the kiln.

Pressure. Pressure regulation has as many applications in the process industries as temperature regulation. Fig. 17 shows a pressure regulator controlling the back pressure on absorbers in a natural gasoline plant. These are very important in pressure cracking and distillation of petroleum. A pressure control installation on platen presses can be seen in Fig. 18. Recording thermometers are also mounted on these presses.

Temperature-Humidity. It has been found that in many places, the temperature of the air and the percentage of relative humidity in it have a direct bearing on the rate of production, quality and even the weight of the product.

Very often moisture is added to air while cooling it at the same time. On the other hand, it may be necessary to withdraw moisture from the air to obtain low relative humidity. This is necessary in some industries; in others moisture must be added some of the time and removed at other times.

In some plants these two conditions are controlled to keep effervescent granules dry and free-flowing, while in the case of some textiles, its function is to prevent the fibres from becoming either too moist or too dry—to bring them to the most desirable moisture content and hold them there until the manufacturing processes are completed.

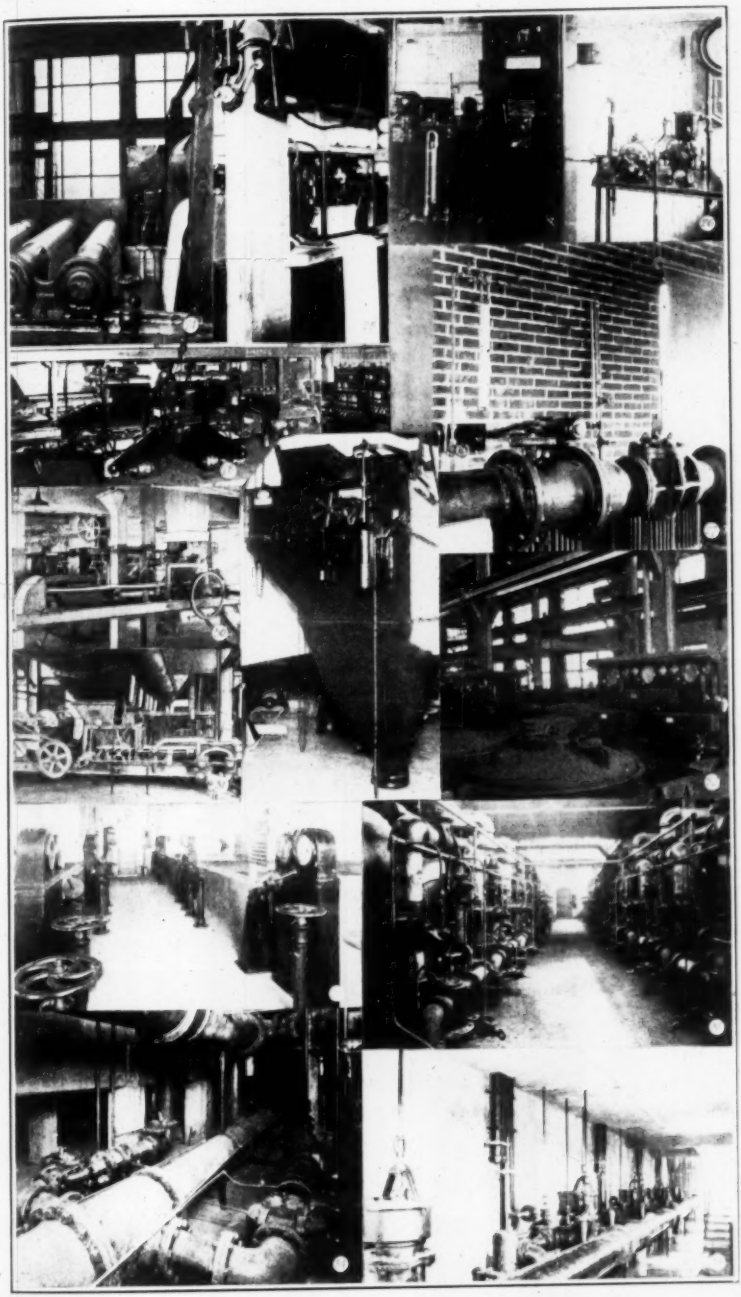
Installations of controls for this latter purpose are given in Figs. 19 and 20.

Temperature-Time. Very often it is important to control temperature in its relation to time of rise and hold. Temperature-time controllers will automatically control temperature, according to any pre-determined time and temperature schedule. The temperature can be either increased or decreased at a gradual or rapid rate in step, or a combination of both.

Fig. 21 shows a temperature-time controller on a tire vulcanizer while Fig. 22 shows the same type instrument applied to a dye kettle.

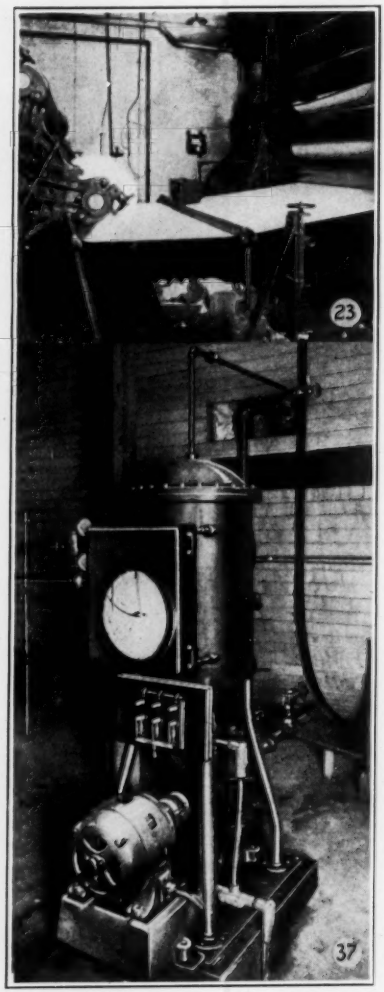
Composition. It is often necessary to maintain uniform acid or alkali strength in solutions. The results obtained with automatic control are far superior to those with manual control.

In Fig. 24 is shown an acidity control unit, consisting of a conductivity cell with two fixed electrodes immersed in the solution. A current of electricity flowing from one electrode to the other will increase or decrease as the solution strength rises or falls. To control the concentration, a conductivity cell in the bath is made a part of the electrical circuit in



an instrument that is sensitive to changes in conductivity, and which responds in one direction to an increase and in the opposite direction to

a decrease in concentration. In responding to such changes the instrument operates a valve mechanism that regulates the flow of chemical to the bath, until the conductivity is equal to that of a solution with the required concentration. Fig. 25 illustrates the recorder controller.



Another application of composition control is the maintenance of the constant calorific value of mixed gases. Fig. 26 shows a Thomas calorimeter, and quick acting controller, while Fig. 27 shows the valve which is controlled and which mixes a rich gas with a lean gas.

Weight and Volume. It is very often necessary to weigh or measure out definite amounts of solids or liquids in the compounding of materials. The importance of this need not be pointed out.

A battery of weighing devices for compounding materials is seen in Fig. 30; another group for proportioning materials in the manufacture of artificial magnesite is shown in Fig. 31. Fig. 28 shows a combination conveyor scale weighing barytes and coke breeze at a chemical manufacturing plant. Fig. 29 shows an apron feed sacking scale.

Flow. In some processes it is very desirable to regulate the flow of liquids to maintain a uniform rate of filtration. With a sand filter unless a controller is installed the raw liquid will pass through the sand bed at a higher velocity when the sand is clean than when the coagulated deposit has accumulated on the surface of the bed. Obviously, at high velocities the impurities penetrate farther into the bed and may even pass completely through.

Sudden changes or increases in the rate of flow must be avoided if the filtering medium on surface of bed is to remain unbroken and efficient.

Such a controller in a chemical plant is shown in Figs. 33 and 34. Fig. 33 is a view of the gages while the controllers are shown in Fig. 34. Other installations are shown in Figs. 35 and 36.

Specific Gravity. It is very often desirable to control the specific gravity of solutions to maintain constant composition of the fluid in circulating systems. The gravity controller shown in Fig. 37 controls the feed rate of one of the constituents. The same device can be used to control the evaporation of sugar-juice.

Cycle Control. Cycle controllers will speed up and maintain quality, and by the complete elimination of the human element insure accuracy. The one illustrated in Fig. 32 is built to perform a complete cure of a rubber tire. A number of cams mounted on a rotating shaft are arranged so that each cam controls the operation of a separate diaphragm valve or other such device affecting the cure, the safety provisions, etc. Controllers can be furnished to perform more automatic operations by using a longer cam-shaft.

Conclusion. Automatic control equipment, like other equipment, is sometimes purchased on the basis of hunch, whim or passing fancy. There is a growing tendency in modern industry to replace prejudice by analysis. The problem of automatic control should be approached with the sole idea of investing money wisely.

Before a selection of control equipment is made, the following points should be considered with each type:

1. Initial cost
2. Rate of depreciation
3. Cost of maintenance and supervision, and
4. Probable savings obtainable.

The last item, while it is the most important, is usually difficult to estimate because of the intangible nature of some of the elements involved. Generally only a rough evaluation of these factors is possible, but this is no reason for overlooking them. They exist and it is certainly better engineering to make an "educated guess" at their value than to entirely overlook them.

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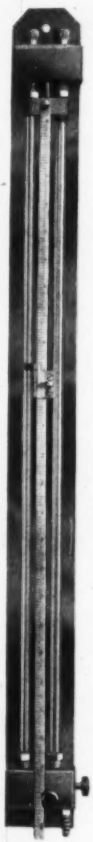
New Instruments

Recently Developed by Instrument Manufacturers

Write Information Section, Instruments Publishing Co., Pittsburgh, Pa., for additional information.

The Culver Universal Differential Gauge

(*Crescent Engineering Company*)



THIS gauge was designed by Prof. Edward P. Culver of Princeton University, primarily for use in the hydraulics laboratories of the School of Engineering. The gauges formerly used for this service were subject to several vexatious shortcomings, chief among which were: leaks; sticking cocks; inconvenience in replacement of broken U-tubes; and in filling, draining, and cleaning the tubes.

The usual U-tube construction has been altered so that standard straight glass tubes can be employed. These are secured by stuffing boxes into an upper header and a lower header, which in turn are fastened to a re-inforced metal back.

The pressures to be investigated are transmitted through copper tubing to needle-valves (not shown in the accompanying cut), which are screwed into tapped holes in each end of the upper header, thence, through drilled passages, to the upper ends of the respective glass tubes. The lower header is provided with a drilled passage connecting the bottom of each glass tube, and also a valve controlling an outlet from this passage to a drain connection. For hydraulic uses, it is, of course, essential to provide a positive method of ridding the upper header of air which becomes trapped there in normal use, and the presence of which produces incorrect readings. This is cared for by the provision of venting valves directly above the glass tubes, by opening which air is driven from the header passages into a drain tube discharging at the lower extremity of the gauge. A second important function of the venting valves is that, by their removal, a clear passage is opened, by which the glass tubes can be withdrawn or replaced without any more inconvenience than the loosening of the stuffing boxes. The bores of the tubes can also be easily cleaned through these openings.

In filling the gauge with mercury, or other indicating liquid, difficul-

ties from air-binding and slopping are eliminated by filling the gauge through the so-called drain connection in the lower header. This is accomplished by the use of a small cup connected temporarily by rubber tubing with the drain nipple. The filling cup, containing mercury, may be elevated to the height required to fill the gauge to the precise level desired, air being vented from the tops of the tubes through the venting valves. This method of filling the gauge has proven to be a very convenient and satisfactory one in practice.

In order to insure correct readings even by observers not familiar with the gauge, it is made direct reading. That is, the difference in height of the columns in the two tubes is measured directly, by adjusting the zero mark of the top of the metal scale at the height of the upper column, then adjusting the scale rider to the position of the lower column. The sliding scale, may be securely locked in position, and the rider can also be secured to the scale—although in practice these locks are not found necessary. The scale and its runner are so designed that they may be adjusted to the precise column heights without effort; the front of the gauge-back is chromium plated and polished to a mirror surface, eliminating parallax, and the rider is provided with a vernier reading to one one-hundredth of an inch.

All parts of the gauge (except the glass tubes) are of metal, attractively plated. All parts coming in contact with mercury are steel.

The uses of this gauge are many and varied. As a differential gauge, it is especially suitable in determining the rates of flow of liquids and gases, in conjunction with the Venturi, orifice, pitot tube, and pitometer; also, in determining the loss of head due to length of pipe, fittings, valves, meters, and change of section.

As a manometer, one side only is connected to the pressure vessel, the needle-valve at opposite end of the upper header being open to the atmosphere. Uses of this class include: the determination of pressure in piping (such as gas piping); pressures in ventilating and draft systems; level of liquid in a distant tank. As a vacuum gauge of precision, this instrument is suitable for determining condenser pressures, suction pressures of pumps under test, and the like.

The gauge may also be used as a specific gravity gauge, determining this by direct comparison with water or other liquid.

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After May 1st the Pittsburgh office of The Bristol Company will be located at 428 Frick Building, Pittsburgh, Pa.

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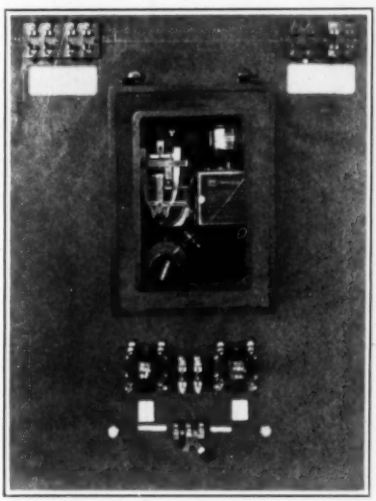
Cutler-Hammer, Inc., Milwaukee, Wis., announce the establishment of a warehouse at Cleveland, Ohio. The company has leased 1600 square feet of floor space for the storage of stock for quick deliveries. A complete line of standard motor control equipment and wiring devices will be available for immediate shipment.

Automatic Frequency Controller-Proportional Step Type

(Leeds & Northrup Co.)

FUNDAMENTALLY the purpose of the equipment is to control frequency within relatively close limits by direct connection of a controller to the governor regulating motor on a steam or hydro-turbine. The controller is of a proportional step type, which automatically sends out an impulse to the turbine governor regulating motor proportional to the frequency deviation from the control point. If frequency is low a definite amount, the controller will transmit an impulse to the regulating motor of a duration and direction suitable to cause the governor to speed up the turbine and bring the frequency to the control point within close limits. The converse applies if frequency is high. Since the controller operates in steps proportional to the frequency deviation from the control point, there is no tendency for the control to overtravel or "hunt."

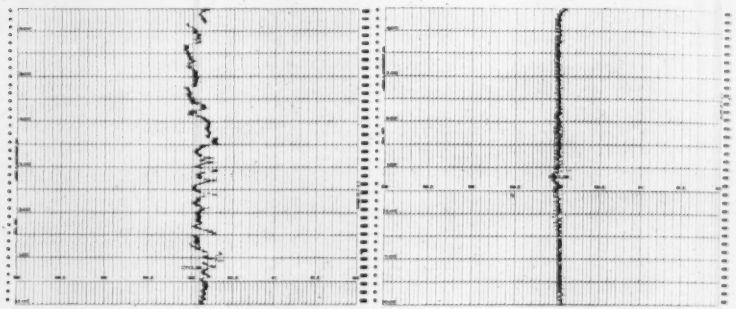


The control point on an instrument adapted for nominal 60 cycle operation may be adjusted over a range from 59 to 61 cycles. This adjustment can be made at any time to overcome any slight cumulative frequency error and hold a correct average as indicated by a synchronous clock.

In a typical installation the "raise," "lower" and "common" leads from the controller are connected through suitable relays to the turbine governor regulating motor. If there are several turbo-generators in the power station, the automatic control can be placed on the largest

machine and the others will naturally keep in synchronism with it so that the effect will be sufficient to control the whole station and possibly the whole system. When the control is connected to a single turbo-generator and the frequency is at the normal point, the load should be somewhat below full generator capacity so that there is a leeway for governing.

Two frequency charts taken from the same recorder on the same power system under hand regulation of frequency and under L. & N. automatic frequency control are shown here.



MANUAL CONTROL L & N AUTOMATIC CONTROL

These charts were made by an L & N Frequency Recorder with a range from 58 to 62 cycles. Charts are normally 10 inches wide. Accuracy guaranteed within ±0.1 cycle

The mechanical parts of the controller are identical to those that have been employed for years in our proportional step temperature controllers in installations where absolute dependability is required of the instruments.

In the foregoing description we have considered the connection of only one turbo-generator to the controller. If the station or system connection is of such nature or proportion that one turbo-generator cannot handle the load fluctuations to maintain frequency, two or more machines may be connected in parallel to a single controller. In this case, however, it will probably be found necessary to adjust for the differences in characteristics and sensitivity of the turbine governing mechanisms. This adjustment can be easily made by inserting proper resistances in some of the individual control circuits to equalize the effect of the control impulse on all turbines.

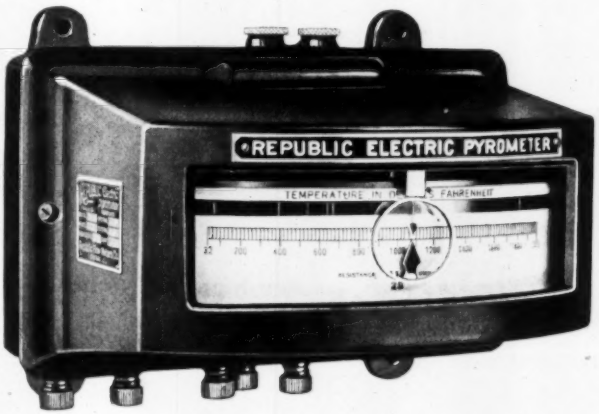
A frequency controller of this type has been in operation for some months at the Wallenpaupeck Station of the Pennsylvania Power & Light Company. This is a hydraulic station. Load fluctuations are particularly active on this station and prior to the installation of the frequency control equipment, it was extremely difficult to regulate frequency. It is now reported that frequency is being controlled to better than 0.1 of a cycle continuously and averaging within ±0.05 of a cycle.

A New Control Pyrometer

(Republic Flow Meters Company)

THE new Republic Control Pyrometer is a combination of pyrometer, control apparatus and switching means. It is complete in itself and in the majority of applications to which it may be adapted, it requires no auxiliary relay apparatus of any kind.

The outstanding feature of this control lies in the elimination of all metallic contacts which have been the weak link in control practice up to date.



The Pyrometer consists of the standard Republic high resistance, double pivoted type millivoltmeter system.

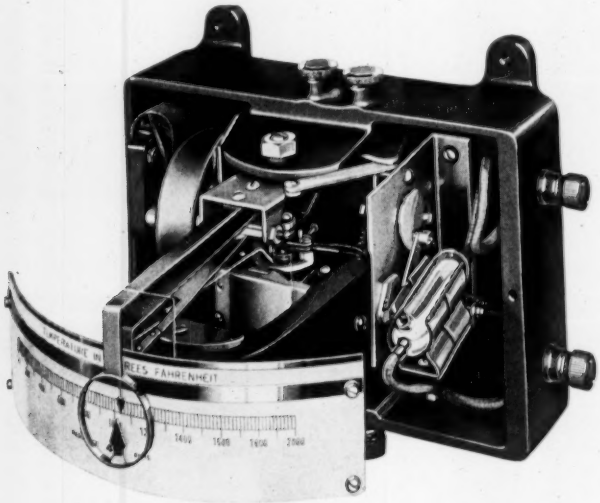
The control mechanism is a purely mechanical device that might be described as a "selector" system or as a reversing clutch system. In general it consists of a small synchronous motor device which operates a very simple mechanical motion in such a way that the position of a power lever is determined by the position of the sensitive pointer.

The action is as follows: A crank arm directly connected to the motor lifts the lever, which throws the switch on and off. This crank arm is guided by a selector cam whose position is in turn determined by the position of the depressor. When the temperature is below the given setting, the depressor passes the pointer on its downward stroke and sets the crank arm so that it turns the switch "ON". The switch then remains in this "ON" posjtion until the temperature rises and the pointer intercepts the depressor, preventing it from completing the downward stroke. The crank arm then takes a different position and operates a trip lever which throws the switch "OFF".

The action is positive and continuous. The frequency of the motion

of the depressor can be made to fit the needs of the particular application.

The mercury contactor switch itself represents a great improvement not only in respect to the contacts in the pyrometer, but also to the contacts on the average small relay. The elimination of the small relay, which is necessary in other control circuits, means not only simplification and economy, but also greater durability and longer life with respect to the electrical contacts.



The type of mercury contactor switch used for all currents above 10 amperes involves the mercury to mercury contact, and the make and break occurs inside of a quartz tube which is insulated from the glass sealing tube. Switches of this type will stand up for many years without any deterioration whatever. Years of experience with these switches in the field of thermostatic control has proved their worth.

———— :: ————

Leeds & Northrup Company announces the appointment of Ernest E. Lee Company as exclusive sales representative for L & N metered combustion control apparatus in Northern Illinois, Northern Indiana, Southern Wisconsin and the state of Iowa.

———— :: ————

Through the purchase of adjoining property the Leeds & Northrup Company has just secured 190,000 additional square feet of property including approximately 85,000 square feet of additional floor space in a modern one story building of saw-tooth roof construction, ideally adapted to its manufacturing processes. The new building will be made integral with the present building by means of a connecting wing, on the construction of which work has begun.

New Diaphragm Meter

Type GK

(*Builders Iron Foundry*)

THE diaphragm meter operates by direct mechanical connection to a diaphragm which is moved by direct fluid pressure transmitted from an orifice in the main pipe line. Electric transmission is not employed.

The orifice in the pipe line creates a pressure differential as the fluid passes through it. This temporary drop is small and almost completely restored. The high pressure upstream and the reduced pressure downstream, transmitted through two pressure pipes of any reasonable length, act on either side of the special rubber diaphragm of the instrument. The diaphragm, restrained by two phosphor bronze springs and partly supported by a conical shield, is displaced by the difference in pressure from the orifice. This movement is transmitted through a crank and shaft to an indicator hand which, due to the design of the diaphragm shield, moves nearly in proportion to the rate of flow over the range of the instrument. The shield also protects the diaphragm and prevents a change of area as it ages. (The diaphragm will last several years and can be changed in a few minutes by an intelligent workman.) The entire diaphragm case is of heavy bronze and is completely outside of and separate from the instrument case.

The indicator dial hand points to the rate of flow at any particular time and follows any change of rate instantly. The indicator scale (graduated from 0-100 units) is fourteen inches long and has large white figures and graduations on a black background, making it visible from a considerable distance. This type of dial is most easily read.

For convenience in studying daily flow conditions both at the time and later a continual chart record of the rate of flow is desirable. The 8″ circular chart turns on a stationary disc, and is driven by a heavy duty Warren Telechron Electric Clock motor (normally rated for 110 volts, 60 cycles, alternating current) making one revolution daily. The chart, like the dial, is decimally graduated, so that readings are directly in percentage of maximum and are multiplied by a constant supplied to obtain actual quantities. The chart record is written by a capillary pen which holds a large supply of ink at one filling. The charts are of uniformly fine quality.

The counter, showing the total flow, is operated by a pawl and

ratchet. The pawl is driven by the chart clock motor and moves the ratchet a varying amount depending on the position of the chart pen (i.e., the rate of flow). The counter is of the straight reading type, similar to that found on a speedometer. It can be read easily by any one.

The meter is conservatively guaranteed accurate within three per cent of the indicated flow over a range from maximum to one-fifth maximum flow. The zero setting of the meter can be checked at any time without disturbing the flow or opening the instrument case.

The type GK is designed to mount on a wall bracket. It stands two feet high and projects 18 inches. The absence of mercury makes close levelling unnecessary. Its small size, together with the fact that it may be mounted either above or below the pipe line and at any distance up to 100 feet from the line, makes it a very convenient and adaptable instrument.

Type Y Venturi Meter

(Builders Iron Foundry)

THIS register translates the pressure differential set up by the flow through the standard Venturi meter tube, nozzle, orifice or other primary device into the units of measurement desired. Two mercury wells, which receive the inlet and throat pressures from the primary device, are attached to the back of the register. These wells are connected at the bottom. A float, travelling in the upper well, transmits any change in rate of flow (i.e., change in mercury level) through a rack, gear and cam to the indicator dial hand.

When used with a Venturi meter tube or nozzle the mercury wells are designed for a maximum differential of 22½″ of mercury; when used with an orifice, for a maximum differential of either 60″ or 120″ of water (4.76″ or 9.55″ of mercury.

The interior parts of the register are of corrosion-resisting metals such as bronze, stainless steel, and monel metal. The bezel rims of the dials are black enameled and fitted with plate glass. The exterior of the register is neatly finished and harmonizes pleasingly with other high grade instruments for water works, industrial or power plant service.

A complete chart record of the flow is of particular value in studying the details of water supply, industrial plant operation, etc. Such a record is

supplied continuously by the daily (or weekly) chart, 10" diameter.

The total flow can be read on the counter dial in gallons, cubic feet, pounds, etc. This dial is supported in such a manner that the integrating wheel is pressed by a spring against a vertical rubber-covered disc revolved at a constant speed by a clock movement. With no flow the integrating wheel is in a position to stop all movement of the dial hands When flow begins the angle of this integrating wheel is altered with reference to the disc and the counter hands rotate in exact proportion to the rate of flow. The four small dial hands and the one large hand all move in a clockwise direction; the large hand, the most rapidly moving of all, travels around a circle two and one-half inches in diameter, graduated in one hundred divisions. These features assure easy and accurate reading of counter totals.

If desired, the counter dial can be omitted and the Type Y furnished as an indicating-recording instrument only. If for any reason it later becomes necessary to have the integrating feature this mechanism can be attached.

The indicator hand at the top of the instrument travels along the arc of a circle 60° or 8½" long. The graduations are practically uniformly spaced and show the rate of flow in gallons per minute or per day, cubic feet per second, pounds per hour, etc., as desired. The surface of the dial has a lustrous, permanent black, oxidized finish with deeply engraved graduations in white enamel.

For use with orifices a decimally graduated indicator dial and chart is provided. Complete list of factors covering all ranges of orifices used is furnished with the meter.

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Johnson Fuse and Voltage Tester

A LOW priced voltage and fuse tester, of watch case size, known as the Johnson Fuse Tester, is being placed on the market by the Electric Tester Manufacturing Co.

It is positively safe and fool-proof in the hands of a novice. It is a reliable and time saving device for the electrician and is constructed to stand hard usage as a tool. The tester can be used on both direct and alternating circuits.

The new tester consists of a resister coil and other parts inclosed in a heat resistance circular case 2¼x1 in. in size. The small indicating lamp which burns dimly at 100 volts, and brightly at 250 volts, is a standard flash light bulb of 6.2 volts. The lamp can be quickly replaced, if necessary, with an ordinary flash light bulb, or can be purchased at any neighborhood garage, electric, hardware or drug store. The construction protects the bulb from breakage. All other parts are indestructible. There are no moving parts to get out of order. With reasonable care

the tester should last a life time. The tester may be had with stiff 6 in. leads for general use, or flexible 18 in. leads for "trouble-shooters." The latter has one lead equipped with an insulated clasp.

For many years the Electric Tester Manufacturing Co., has been supplying industrial users of electricity with its Universal Fuse & Circuit Tester, which tests voltages from 100 to 600. As only about 10% of users of electricity come under the higher voltage classification, it was felt that a small tester of popular price would fill a need for the average user who has no occasion to test circuits over 250 volts.

So simple an act as testing or replacing a fuse should not depend upon the inconvenience of waiting for a power company service man, nor should it incur the expense of calling an electrician. This small watch case tester, of popular price, was designed to meet this need in our increasing dependence upon electricity. Its advantage as a saver of time and temper in every home, theatre, restaurant, apartment, hotel, store or industrial plant, is apparent.

For the expert electrician it is not only a practical and time saving instrument, but it substitutes a scientifically reliable and absolutely safe testing device for rule-of-thumb methods, guesswork and dangerous practices. The antiquated method of using a lamp in an old open socket is always dangerous. A 220 volt lamp is seldom available and there is therefore, always the chance, when using the 110 volt lamp for testing, that one may come in contact with 220 volt circuit, which will cause the lamp to explode. Serious injuries to face, eyes and hands from this source, as well as when replacing burnt-out fuses, is all too frequent.

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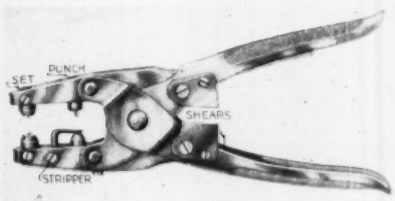
Tape Repair Outfit

(Pittsburgh Machine & Instrument Company)

THIS tool is intended for the engineer in the field, for shops and warehouses where steel measuring tapes are in constant use. The outfit can be carried in the pocket or in the tool box; it is about 8 inches long. To make a complete repair to a steeltape all necessary appliances are attached to the tongues:

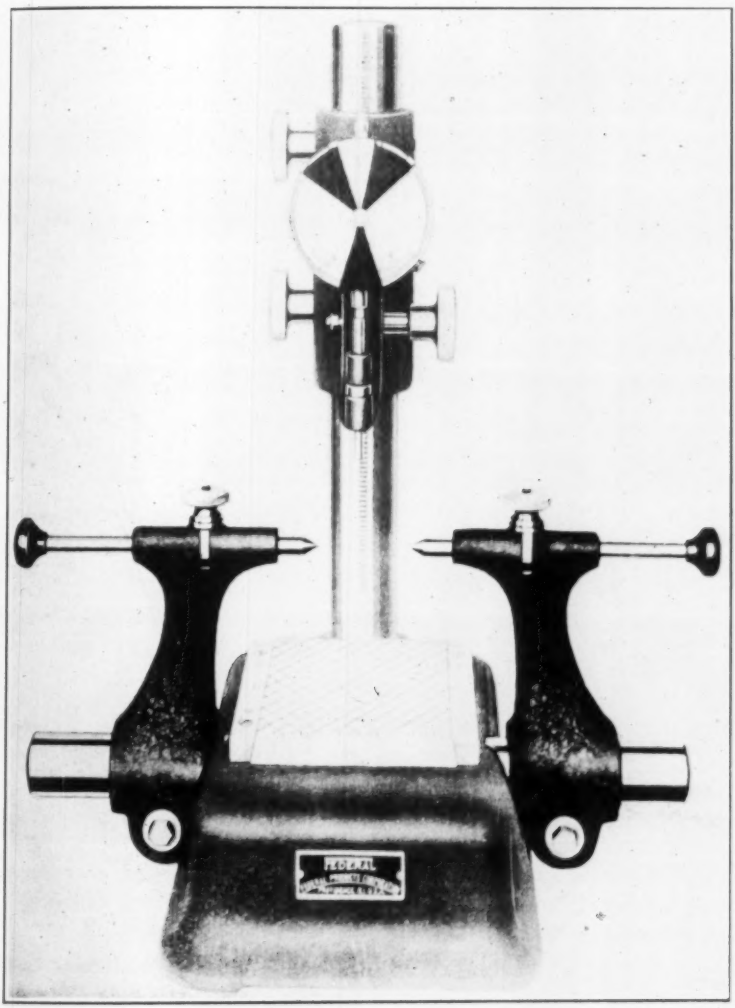
Shears, Punch and Rivet Set. The Shears will cut steeltapes such as are ordinarily in use; the Punch will cut through two thicknesses of the tape where the splice laps over and the Rivet Set at the end of the jaws will take care to complete the job. The holes through which the rivets pass can be cut near the edge of the splice without any danger of splitting the tape.



A New Comparator

(*Federal Products Corporation*)

THE new comparator is plainly shown in the illustration. It can be equipped with roller type V-blocks or centers. A special limit reading dial is shown in the figure. The V-opening can be set to any + or − limits, if the needle is not in the V-opening the measurement is not within the limits. One graduation on the dial equals .0001".



The comparator weighs 78 lbs., is 20 inches high, and has a base 12 x 9 inches. The maximum height between the table and the feeler of the gauges in 8 inches. The accessory parts have the following weights: V-blocks, 17 lbs.; Centers, 10 lbs.; Bar for holding V-blocks and centers, 8 lbs.

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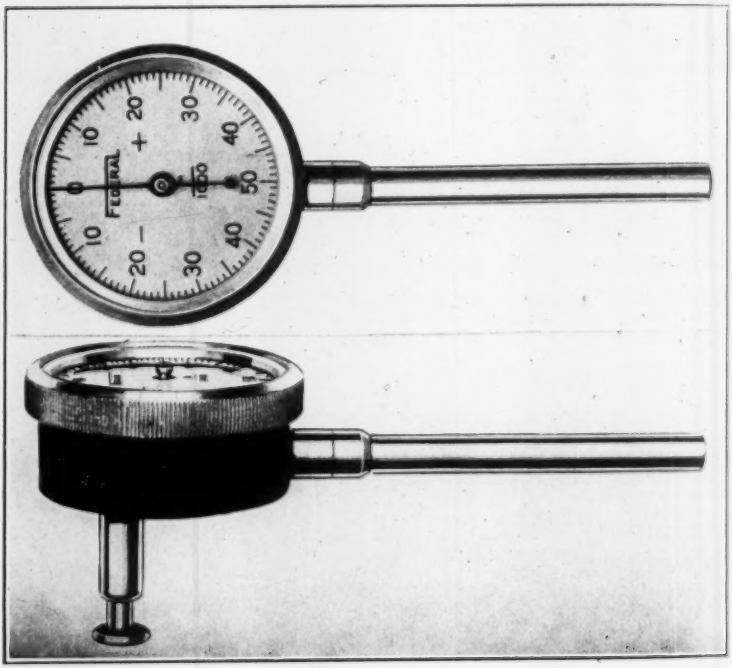
Model 80 Junior Dial Indicator

(Federal Products Corporation)

THE Model 80 Junior is similar in construction to the Model 80, which has been on the market for several years. It is much smaller in diameter, this being 1-23/32" and the holding bar is 2-3/8" long by 1/4" in diameter. Special sizes of holding bars can be furnished.

This gauge can be furnished either with or without jewel bearing movement. The racks are chromium plated and the movement is a separate unit asserting perfect alignment.



The stem is cast integral with the case, eliminating the necessity of using solder. The entire movement can be removed for cleaning or repairing in less than 2 minutes.

The range of the indicator is .200" and the dial can be furnished graduated either 0-50-0 or 0-100.

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Addoweight Totalizing Dial Scale

The Merrick Scale Mfg. Co., Passaic, N. J., have issued Bulletin 1127 which illustrates the cycle of operation of their totalizing dial scale.

Apron Feed Automatic Scale

Bulletin 1224G published by the Richardson Scale Co., Clifton, N. J., very thoroughly describes and illustrates their apron feed automatic scale for crushed, lumpy and granular materials.

Bulletin 2927 shows this scale applied to the sacking of ammonium sulphate.

Automatic Humidity Regulation

Parks-Cramer Co., Fitchburg, Mass., have issued Bulletin 921, which discusses the advantages and possibilities of automatic humidity regulation.

Automatic Temperature Control in the Chemical and Allied Industries

The Fulton Company, Knoxville, Tenn., have issued Bulletin T-108 which discusses and illustrates the application of their temperature control devices to the Chemical Industries.

Central Station Humidifying and Ventilating

Bulletin 332 issued by Parks-Cramer Company, Fitchburg, Mass., discusses the application of central station humidifying and ventilating.

Convey-o-Weigh

Bulletin 1629G published by the Richardson Scale Co., Clifton, N. J., describes a conveyor scale for weighing lumpy, crushed, granular and powdered materials.

Conveyor Weightometer

The Merrick Scale Mfg. Company, Passaic, N. J., have issued Bulletin 1224 which describes and illustrates their conveyor scale for continuous weighing.

Continuous Weighing Scale

Form 0386 of the Toledo Scale Co., Toledo, Ohio, illustrates various applications of their continuous weighing scale.

Diaphragm Meter

Bulletin No. 236 of the Builders Iron Foundry, Providence, R. I., covers their diaphragm meter which registers, indicates and records the flow of fluids.

Dial Indicator

The Federal Products Corp., Providence, R. I., has issued a leaflet on their new Model "80" Jr., dial indicator.

Drying Clay Products

The Carrier Engineering Corp., Newark, N. J., are distributing a booklet with the above titles. This is an excerpt from the book "Drying and Processing of Materials by means of Conditioned Air" prepared by their Technical Staff.

Filter Rate Flow Controllers

Filter Rate of Flow Controllers for Water Works and Industrial Plants are taken up in Bulletin 28 of the Simplex Valve and Meter Company, 68 & Upland Sts., Philadelphia, Pa.

First Thing to Think of When Choosing a Pyrometer

is the title of a leaflet issued by the Leeds & Northup Co., 4901 Stenton Ave., Philadelphia, Pa.

Gas Service Journal

The March issue of the Gas Service Journal published by the Pittsburgh Equitable Meter Co., 400 Lexington Ave., Pittsburgh, Pa., contains the following articles: Ideal Distribution Systems for Communities of 250 to 1500 Meters; The Flow of Gases.

Humidifiers—Their Principles and Characteristics

Bulletin 228 published by Parks-Cramer Co., Fitchburg, Mass., very thoroughly describes and illustrates Park Spray humidifiers.

Hopper Scales

Form 0626 of the Toledo Scale Company, Toledo, Ohio, illustrates their hopper scales.

Laboratory

Vol. Two, Number Two of the Laboratory published by the Technical Service Department of the Fisher Scientific Co., 711 Forbes St., Pittsburgh, Pa., has featured Herbert Hoover—Scientist. A number of short articles cover new instruments.

Manufactured Gas

The Consolidated Ashcroft Hancock Co., Inc., 100 E. 42 St., New York, has published a book entitled "Manufactured Gas." This book is Vol. I of the American Instrument Manuals and was published to aid the

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Meat Packing

The Consolidated Ashcroft Hancock Co., Inc., 100 E. 42 St., New York, has also published a book with the above title. This is Vol. II of the American Instrument Manuals and is published to help the meat packer improve the efficiency of his plant. Price $1.00.

Mercoid Controls

is a title of a booklet issued by the American Radiator Company, 40 West 40 St., New York. It furnishes a brief description of the Mercoid Controls and allied devices.

Phase Sequence Indicator

Price Sheet No. 514 on the Standco Phase Sequence Indicator has just been issued by Herman H. Sticht & Co., 21 Park Row, New York.

Poidometer

The Schaffer Poidometer Co., 2828 Smallman St., Pittsburgh, Pa., have published a bulletin on the Schaffer Poidometer—a most accurate and durable weighing machine for the automatic weighing of crushed, granular and pulverized materials and also for measuring liquids.

Regitherm

An instrument for automatically controlling air temperatures manufactured by The Fulton Co., Knoxville, Tenn., is described in Bulletin R-102.

Thermo-Relay for Magnifying Galvanometer Deflections

is briefly described in a leaflet issued by N. V. v. h. P. J. Kipp & Zonen, Delft, Holland.

Temperature Control of Refrigeration Systems

Bulletin T-106 published by The Fulton Co., Knoxville, Tenn., covers the Sylphon temperature regulators for temperature control of refrigeration systems.

Temperature Control

A leaflet of the Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill., shows a number of applications of the Powers control by diagrams and photographs.

Tycos Rochester

The April issue of Tycos Rochester published quarterly by the Taylor Instrument Companies, Rochester, N. Y., contains the following: Defining Aircraft Altitude Records; Aviation and the Weather; Weather and Health; Phantom Thunderstorms; Apparatus Measures Resistance to Flow of Heat in Homes; Some Old-Fashioned Weather; Region of Greatest Snowfall in America; The Thermometer as the Modern Divining Rod; and other articles.

Unit Air Conditioner

A leaflet entitled "The Carrier Unit Air Conditioner" published by The Carrier Engineering Corporation, Newark, N. J., covers manufactured weather in industry.

Venturi Meter

Bulletin No. 232 of the Builders Iron Foundry, Providence, R. I., describes their Type Y Venturi Meter Register — Indicator — Recorder.

Venturi Direct Acting Filter Controller

Bulletin No. 233 of the Builders Iron Foundry, Providence, R. I., describes their filter controller for controlling the flow through sand filters of town and city water works.

Universal Differential Gauge

The Culver Universal Differential Gauge is described in a leaflet of the Crescent Engineering Company, 1205 East 25 Street, Baltimore, Md.

The Whittemore Strain Gage

The Southwark Foundry & Machine Co., 400 Washington Ave., Philadelphia, Pa., have issued a booklet which describes the Whittemore Strain Gage in detail. Instructions for its use are also included.

What Price Power?

Bulletin 2129 published by the Richardson Scale Company, Clifton, N. J., describes the application of scales to the automatic weighing of the coal supplied to boilers.

Weather Vein

Vol. 8, of No. 4 of The Weather Vein, published quarterly by the Carrier Engineering Corp., 850 Frelinghuysen Ave., Newark, N. J., contains the following: Trade Marks; The Versatility of Manufactured Weather; The Value of Manufactured Weather; Evidence; etc.

Water Works Journal

Published by the Pittsburgh Equitable Meter Company, 400 Lexington Ave., Pittsburgh, Pa., contains the following articles in the March issue: The Cincinnati Water Works; Water Supply for Park Developed; Santa Ana, California Storage Tank.

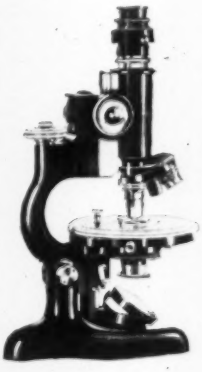
Weighing on the Fly Means Saving

Bulletin 1228 of the Merrick Scale Mfg Co., Passaic, New Jersey, illustrates the various applications of their scales in industry.

Watch This—and Control the weight of your continuous sheet product in process foot-by-foot

A booklet issued by the Toledo Scale Company, Toledo, Ohio, shows the application of a special scale, which indicates the deviations of weight of sheet material from standard thereby avoiding calipering and sampling.

See the



New Chemical Microscope

at the

N. Y. Chemical Exhibit

THE new B & L Chemical Microscope will be on exhibit at the New York Exhibition May 6 to 12.

It has been designed according to specifications of Drs. E. M. Chamot and C. W. Mason of the Laboratory of Chemical Microscopy, Department of Chemistry, Cornell University. Several important improvements have been made—notably a new stand, allowing more room for manipulation of specimens, the addition of a circular revolving nosepiece, a rack and pinion substage, a much larger stage, improved attachable mechanical stage, and greatly improved polarizing equipment.

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Taylor Instrument Companies

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Federal Products Corp.

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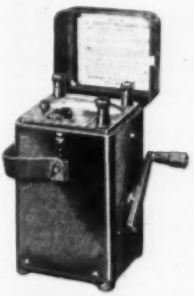

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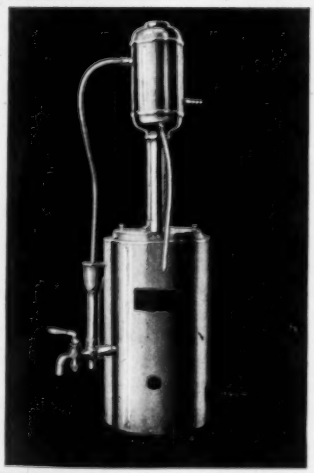

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The editor feels that a file card index will be a valuable asset to all readers. It is suggested that this index information be cut out, mounted on cards, and filed in your desk or in a file box on top of your desk. You will then have within easy reach an index of instrument information of incalculable value.

THE PROPOSED TARIFF AND INSTRUMENTS.
RICHARD RIMBACH, INSTRUMENTS, Vol. 2, No. 5, April 1929, pp. 151-157.

The advertisements of the two German instrument companies are given and the errors in statements made there are pointd out by giving th facts.

LABORATORY APPARATUS AS A MEANS OF WORKS CONTROL.
ARTHUR SCHRODER, INSTRUMENTS, Vol. 2, No. 5, April 1929, pp. 159-167.

Paper read before the Students' Course at the Twelfth Exposition of Chemical Industries.

AUTOMATIC PROCESS CONTROL INSTRUMENTS AND DEVICES.
RICHARD RIMBACH, INSTRUMENTS, Vol. 2, No. 5, April 1929, pp. 169-177. 37 figs.

The importance of technical control is discussed and the activities of the trade associations mentioned. The article then discusses some of the recently developd instruments: Colorimeters, Humidity Controllers, Heat Indicators and Controllers, Liquid and Gas Meters, Acidity and Alkalinity Meters, Viscosimeters, Scales and Balances, Physico-Chemical and Physical Testing Apparatus, Laboratory Glassware, Porcelain and Chemicals.

This article in a general way considers the application of automatic control instruments to processes.

Instruments Book Shelf

Orders for copies of the books reviewed in this section can be sent to Instruments Book Shelf, care of Instruments Publishing Company, 1117 Wolfendale Street, Pittsburgh, Pa.

PROCEEDINGS OF THE THIRTY-FIRST ANNUAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS. Published by the Society, 1929. Cloth. Part I. 1184 pages, Part II. 904 pages. Price $6.50 each.

REVIEWED BY D. L. MATHIAS

Part I contains the annual reports of 45 committees on research and standards. Part II 46 technical papers of pertinent content on materials of construction.

STANDARDS YEARBOOK 1929. Issued by the U. S. Bureau of Standards. Published by the Government Printing Office, 1929. Paper. 401 pages. Price $1.00.

REVIEWED BY D. L. MATHIAS

Each succeeding issue of the Standards Yearbook records a story of steady progress and accomplishment in the development of practicable commercial standards and their acceptance by a large proportion of industrial organization. The edition of 1929 is no exception. Besides the general growth of the standardization movement as revealed in the membership, activity, and expanding scope of the world's standardizing agencies, there is a section devoted to the work of the National Bureau of Standards, reporting more than two hundred and fifty specific projects in a wide variety of industrial fields, which, through co-ordination of scientific, industrial, and commercial research, have resulted in much valuable information regarding materials, processes, new applications, specifications, methods of test, and units of measurement.

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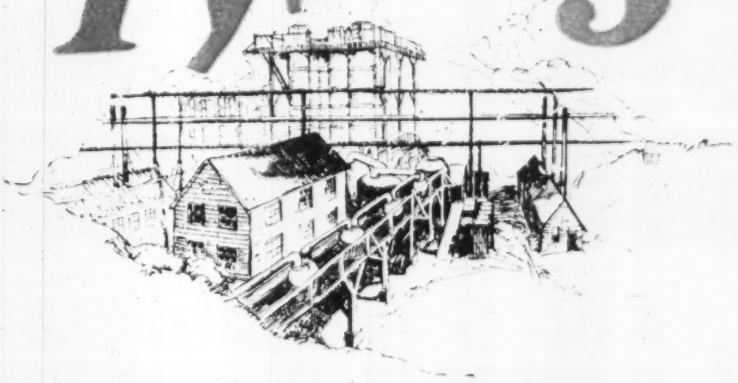

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